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BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
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Freight traffic on British Railways,

by H. R. Barrett,

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Transport, like heat, light and power, is a primary essential in any community. The more progressive the community the greater is the need for its transport services to match that progress; the more efficient the transport, the more can that community flourish. Great Britain is a community to which that truism applies with especial force.

Despite the growth of a new source of power through oil, which has placed alternative or supplementary facilities at the disposal of modern communities with expanding needs, the oldest railway system in the world serves, and will continue to serve, the transport needs of this compact and highly industrialised island faithfully and efficiently.

It may be of interest, at the outset, to note the area and population served by British Railways, i.e. - England, Wales and Scotland, in relation to a few other lands with highly developed rail systems.

Country.	Area Sq. miles.	Population.	Population per sq. mile
England, Wales and Scotland.	87 815	48 840 893	551
Belgium	11 750	8 703 000	750
France	213 000	42 000 000	187
Netherlands	13 514	10 327 000	756
Canada	3 845 000	14 430 000	4
U.S.A.	2 977 000	150 697 000	49

The centres of industry and population in Great Britain are, by world standards, small and compact, being sited in relation primarily to coalfields, sources of indigenous raw materials and ports for imported raw materials and exports of finished products.

Such concentrations are in relatively close proximity to each other and to ports. For instance, Birmingham, the second city of England and chief centre of the hardware trade, is practically equidistant from the other important trade centres being but 112 miles from London, 81 from Manchester, 88 from Bristol and 110 from Leeds. The Potteries and the Midlands are but a stone's throw from each other and 50 and 80 miles respectively from Liverpool's docks. The textile centres of Lancashire (cotton) and Yorkshire (wool) are separated only by the Pennine hills and one is on the doorstep of the ports of Manchester and Liverpool with the other within 60 miles of Goole and Hull.

Outside the industrial areas an extensive and intensive agricultural industry with 18 million acres of arable land, 13 millions of permanent grassland and 17 millions of rough grazing spreads over most of the low land with an annual productivity of 2 million tons of wheat, 2 millions of barley, 3 millions of oats and 1 million of potatoes to mention only the heavier crops.

Ten million cattle, 19 million sheep and 5 million pigs find grazing on the grassland pastures and fell slopes, whilst large tracts of unproductive country, and mountains, are found in the extreme north of England, the uplands of Wales and the north and west of Scotland.

History and national policy.

It was in this setting that the first railways on the globe found their origin in the eighteen-twenties and their rise and development proceeded steadily co-incident with the opening and expansion of the industrial era.

Since the industrial revolution placed Great Britain well adhead, this country has been one of the major work-shops of the world. Whilst adequately supplied with vast reserves of good, cheap coal, the basic source of its power and prosperity, and ores and limestone for steelmaking, the barometer of industrial activity, this crowded island was forced to import the major proportion of its food and the raw materials for its many diverse industries.

Such large-scale imports were paid for by the export of manufactured products and capital goods to all the countries of the world, and particularly to the industrially under-developed but agrarian countries.

The classical fiscal policy of the U.K. for long was based on the principle of cheap food and cheap raw materials which together enabled this small island to enjoy an exceptionally high standard of living. The British worker could, in general, produce far more wealth for himself and the community in industry than in agriculture. One man-hour in manufacturing industry could purchase more food from overseas than could be produced at home in that man-hour. By the processes of international trade he could get just as much food for a fraction of a day's work as would take him all day to produce on British soil.

Nor did that system weaken the country for wartime. A fraction of the manpower that would be needed if the country were to feed herself would build the ships to keep the sea lanes open.

World conditions, largely the outcome of two global wars, have altered the pattern to our detriment and forced an overhaul of fiscal policy. Overseas food supplies are now no longer plentiful or cheap. Payment with industrial output of manufactured goods for cheap food imports is becoming less practicable. An increasing world population, a general demand for a higher standard of nutrition and a growing industrialisation of some primary food-producing lands all operate against our traditional policy. Other lands are becoming increasingly equipped to produce their own manufactured goods and welcome ours the less.

A main factor in present events is, of course, the « dollar famine » which, allied to the foregoing, compels this island to seek to achieve, as nearly as possible, self-sufficiency in food production.

Thus home agriculture, always a large-scale user of rail transport, has assumed an enhanced importance in the national economy which British Railways recognize and will serve still further. The need for raw materials still remains — they cannot be grown here — for the country must continue to export to the limit of its ability, under increasingly competitive conditions if it is to survive with its standard of living unimpaired.

These plain unchallenged facts underline the responsibility of British Railways to the national economy through agriculture, industry and commerce in providing the best and cheapest transport within their power.

The Railway's task.

A glance at the map will show how the railway network, the country's arterial system, carries its lifeblood along the routes that long-established need and practice have laid down and serves to meet any changing needs that defence or industrial re-orientation may impose.

The vital foci are the great ports of entry and exit on the estuaries of the Thames — where lies London — the world's greatest port, Mersey, Clyde, Severn, Humber and Southampton water. The principal coalfields of South Wales, Lancashire, Yorkshire, Midlands, Durham and mid-Scotland were the logical places to site the heavy industries whose factories and sidings grew and extended with rail services to and from the ports organised accordingly.

Public services — gas and power — were of necessity scattered more widely in close proximity to consumers, whilst shipyards grew in the natural setting of the estuaries of Clyde, Tyne and Mersey adjacent to the coal and steel they consumed. Brickworks arose along the Oxford claybelt.

Cotton and wool found their habitat in Lancashire and the West Riding of Yorkshire. Machinery in the North, vehicles in the Midlands, clothing in Leeds, footwear in the East Midlands, steel in Sheffield and South Wales, all found a location peculiarly their own and rail services developed with their growing needs, maintaining regular lines of com-

munication to and from ports, from coalfields and to consuming areas.

Through the years a transport pattern has developed. In the main, industrial traffic flows in regular and well-defined streams and rail services can be set to a reasonably constant pattern with premises, yards and equipment located where the need is heavy and continuous, thus avoiding lengthy periods with costly capital assets standing idle and unremunerative.

The products of heavy chemical plants which are often the raw material of other industries, e.g. rayon, soap and glass, pass in fairly constant daily flows throughout the year to the same destinations. The output of mines and quarries travels with similar regularity to power stations, gasworks, factories, furnaces and docks. Petrol and oils from the large coastal refineries also conform to this pattern.

Other merchandise, though large in volume but highly miscellaneous in character, is distributed to factories, shops and households in the same patterned flow on which are built up the wagon and train services that cover the country.

Thus, Burton brewers, Merseyside millers, Leicester hosiers, Bristol tobacco-men, despatch very similar quantities of their products each week to the same recipients; multiple tailors, chemists, grocers and departmental stores forward weekly lots that fluctuate little to the same wide range of destinations.

Agriculture, embracing horticulture, by its very nature produces a series of crops, in different seasons and areas, whose harvesting period and volume may vary considerably with weather conditions at seed time or harvest, or with price fluctuations as emphasis is artificially moved from one commodity to another, or in relation to availability and price of overseas supplies. Some crops run to peak proportions and by reason of perishability require urgent treatment in transport or marketing. Cornish broccoli and Evesham plums are examples that come easily to mind. Others are capable of storage at source and thus reach the market at a more even rate. These include certain root crops, and, until recent years, the whole of the grain from stack.

Some of these products move in bulk to processors, as peas and plums to canners, barley to maltsters and wheat to millers, whilst most of them eventually find their way in small lots to the kitchen tables of millions of households, either as grown or after processing. For instance, wheat into bread, barley into beer, sugar beet and plums into sugar and jam.

Although rail transport plays a considerable part in all these movements, in recent years it has been shared with the road operator to an increasing extent as the pace of modern life has quickened.

The needs of defence, the spreading of modern industry to locations outside its former traditional boundaries, the import of coal through ports accustomed to export, are some of the factors which, like the agricultural intermittency, pose problems for the railways.

Long years of experience and the flexibility of modern operating control enable these tasks to be performed efficiently and to interweave the seasonal or extra-ordinary movements with the

day-to-day routine business. This is no mean achievement in face of the enforced national policy of restricting expenditure on capital development which bears hardly on a railway system still striving to overtake arrears of maintenance, a legacy from six years of war.

Performance.

The most recent published statistics of British Railways' performance cover 1952. During that year they carried 50 million tons of general merchandise, 170 million tons of coal and coke, 62 million tons of other minerals and the equivalent of a million tons of livestock, principally cattle, sheep and pigs — 283 million tons in all, almost a million tons of freight on each working day in the year, over 19 350 route miles open for traffic fed by 6 500 stations.

The coal carryings, their principal load, amount to nearly 80 % of the deep-mined output of the country available for transport.

Substantial tonnages of other commodities conveyed include :

Bricks and Tiles.
Clay, Sand and Gravel.
Creosote and Pitch.
Crude Steel.
Iron Ore.
Iron and Steel Scrap.
Lime and Limestone.
Manures.
Pig Iron.
Road-making materials.
Sugar Beet.
Animal Feeding Stuffs.
Cement.
Chemicals.
Foodstuffs and Beverages.
Fresh Fruits.
Grain.
Iron and Steel.
Machinery.
Oils.
Paper.
Petrol.
Root Crops.
Timber.
Textiles and Drapery.

The tools for the job.

Railway track, motive power, signalling and terminal equipment are important and expensive aspects of the undertaking, but their sole function is the fundamental one of affording the means whereby rolling stock is moved safely, expeditiously and as cheaply as possible. An adequate fleet of vehicles of types suitable for the traffics they must carry is essential.

British Railways now own roughly 1 100 000 freight vehicles with a total capacity of 14 1/2 million tons. Approximately half are coal and mineral wagons including a large number taken over from private owners on nationalisation in 1948.

To afford universal availability and minimise unprofitable empty running, the ideal would be a single standard type. It would, however, be absurd to attempt to carry in one common-purpose vehicle the multiplicity of commodities moved. Practical and commercial considerations have contributed over the years to the development of the most suitable vehicles. The protective requirements of commodities have been the origin of some — ventilated and insulated meat, fish and fruit vans, steam-heated banana vans, shock-absorbing wagons and vans.

Unusual size, shape or weight of loads account for the design of others — bogie bolsters, plate, pipe, steel and well

wagons — whilst flat wagons cater for tractors and agricultural implements.

Livestock require special vehicles, 13 000 in all, and liquids in bulk are moved in tanks designed for such diverse fluids as milk, ale, petrol, acids, varnish, molasses, wine and even water.

The rising costs of handling the rough, low-rated commodities have compelled more bulk working in many industries and high and low capacity hopper wagons now carry coal, ores, limestone, soda ash, cement, grain and alumina.

Here again long experience and close study of working records indicate the economic stock required of each type. New types, and additions to old, are provided after careful consideration of the need, when each year's building programme is compiled.

To secure the utmost economy in both initial cost of construction and the constant cost of operation British Railways are planning the stock of all wagons, and particularly the general purpose types, to afford the maximum degree of standardisation consistent with well-proved needs for special exceptions. Much progress has already been achieved in this direction. A primary aim is the elimination of the ex privately-owned low-capacity wagons equipped with the primitive grease axle box which restricts availability and impedes the progress towards increased speed of freight traffic which is so desirable today.

The advocates of high-capacity wagons, whose voices often raised have been listened to with attention, will find some measure of satisfaction in the recent decision of British Railways to build larger capacity wagons for their heavy caryings of coal and other minerals.

Previously standardised at 16 tons capacity, the new wagons will carry 24 1/2 tons and two types, flat-bottomed and hoppered, are being developed and produced in line with the needs of the principal users and a steadily rising number of these larger vehicles is confidently anticipated.

The general standard of capacity for normal merchandise vehicles has been fixed at 12 tons for covered vans and 13 tons for open wagons, these being the ratings that experience has shewn to be most suitable for the customary loadings achieved on this railway system.

To haul these wagons a locomotive fleet, excluding passenger engines, of 16 000 freight or mixed traffic locos is available. By far the higher proportion of these are the traditional coal fired steam units but some are electric, diesel and diesel-electric types. Large-scale replacements of steam shunting engines by diesel types are being undertaken and intensive study is being made of the relative merits and economies of newer types of motive power on main-line working with a view to achieving improvement in service so far as is consistent with cost desiderata.

Some 16 000 freight trains are run every day with 425 — 134 more than pre-war — of them running at express speeds. The development of fully-braked freight trains is proceeding apace and with the increasing proportion of new wagons being built fully fitted with continuous vacuum brake, considerable improvements in goods train speeds are appreciably nearer. Typical examples

of principal freight services are :- Aberdeen (fish) to London, 540 miles in 15 3/4 hours, London to Glasgow, 402 miles in 13 hours, London to Liverpool, 194 miles in 6 hours, Plymouth to London, 226 miles in 8 1/4 hours, Leeds to London 198 miles in 6 3/4 hours. Bristol to Manchester 169 miles in 9 3/4 hours, Birmingham to Liverpool, 89 miles in 4 3/4 hours.

Stations and depots.

Freight traffic normally commences and ends its rail journey at a railway goods depot or at a private siding actually on the premises of industrial concerns.

British Railways have approximatively 6 500 stations at which all types of freight traffic are dealt with of which the majority afford a collection and delivery service with cartage facilities based on the station itself or available from other points under zonal concentration schemes which will be discussed later.

These stations naturally vary considerably in size and importance in accordance with the nature of the area they serve — industrial town or country district — and in the degree of facilities and equipment they possess to cater for the particular needs of their staple traffic streams.

The largest is at Bristol (Temple Meads) which with its 15 acres of covered accommodation is also the largest covered goods station in Europe.

Modernisation and mechanisation of goods stations is proceeding continuously and its rate of progress is governed mainly by the extent to which capital expenditure can be sanctioned under the present-day restrictions which bear hardly on all industries in the country.

Few stations are entirely alike in their physical characteristics of site, approach, lay-out and local conditions. Some were built 100 years ago or more and, naturally, were placed as near to town or industrial centres as circumstances would allow. The growth of urban property on increasingly valuable sites around them has made it, in most cases, a physical impossibility to extend their area to cope with vastly expanded needs of this modern age.

This factor, allied to the high cost of manual handling of goods traffic which unlike passengers cannot find its own way to platforms or from train to train, has resulted in a search for mechanical means to fit the need and make possible the more intensive working that area limitations impose.

Many schemes are in operation and regular consideration by a committee of railway experts ensures the further evolution of answers to new problems and extension of refinement of existing installations. Individual industries may find it not unduly difficult to evolve mechanical handling equipment to suit their own specialised needs for certain ranges of materials or products that fluctuate little in size or shape.

Railway problems are less simple in that the flow of traffic over their sheds comprises the most miscellaneous collection of sizes, shapes, weights and degrees of vulnerability to damage. The problem varies station by station and consequently each depot produces its own set of needs and limitations. Railway experts produce the individual answer for each. Thus, according to the lay-out

of the depot and its traffic characteristics, the facilities to be found will comprise the widest possible range of equipment including fixed and mobile cranes, stackers, roller-conveyors, chutes, elevators, power-operated platform trucks, fork-lift trucks, capstans and wagon-discharging machines.

Palletisation, as yet in its infancy in this country, is being developed for domestic application and in conjunction with those industries permitting throughout transit on these lines. Ease of working and reduction of cost may well result for industry and transport alike with the further application of this new transport principle. Experimental wagons with wider doors and improved floors to facilitate loading of palletised traffic have been put into service.

All terminal work is not, of course, confined to shed operations. A good proportion of rail-borne traffic consists of full wagon-load traffic which is dealt with in open yards adjacent to the shed and the problem here is that of efficient and speedy transfer, at cheapest possible cost, of loads from rail to road vehicles or vice versa. Normal shed methods not being applicable, the alternatives are manhandling or cranage (fixed or mobile) but much thought is being given to the possibilities of developing new techniques of transferring road vehicle bodies, complete with load, to and from rail chassis without recourse to cranage which may, at smaller or country stations, be less than adequate.

Consideration of station or depot working would be incomplete without reference to private siding traffic. A high proportion of the coal, coke, minerals and rougher commodities and some finished products originates or terminates at privately-owned sidings actually sited on industrial premises where the responsibility of the railways lies chiefly in the provision and haulage of suitable rolling stock to and from siding entry, loading and unloading being performed by the trader.

Mines, foundries, public utility services and many large industrial plants find rail sidings of great value in servicing their premises for internal working and facilitating the penetration of all departments without recourse to expensive double handling or transhipment. Such direct connection with the main railway system is of undoubted advantage to siding owners and to British Railways who find in such a facility a long term means of retaining to rails traffic that may otherwise succumb to the attractions of road hauliers.

Commercial organisation.

Since nationalisation in 1948 the management of British Railways has been exercised by the Railway Executive, a body comprising members responsible for functional control of the various branches of railway activity — commercial, operating, civil and mechanical engineering, staff and labour relations, etc.

This large national undertaking is divided into six Regions, based broadly on areas previously covered by the former group companies adjusted to some degree by the results of experience. Each Region, under a Chief Regional Officer, has principal officers with corresponding functions to the members of

the Executive, two of whose departments come within the ambit of this article. These are the Operating Superintendent, principally responsible for the actual movement of trains and deployment of rolling stock and motive power, and the Commercial Superintendent with wide responsibilities for the conservation, expansion and development of business, collection, loading, unloading and delivery of traffic with the consequent indoor work involved in rates and charges policy, documentation of traffic, collection of charges, station accountancy, consideration of claims, and matters concerning liaison between the trading community and the railways as carriers.

The Commercial Superintendents of the Regions exercise their control through the medium of their District Commercial Superintendents who are responsible for a manageable number of stations on an area basis, stations being in charge of a Goods Agent, who forms the principal link between railway and customer, supplemented by Railway Service Representatives who, in the principal cities, assist the Agents and are under their charge, or in country areas are attached directly to the district offices.

Services to the trading community.

Consideration of the principal matters within the Commercial Superintendents' purview will indicate the wide extent of the services which are placed at the disposal of the business community in pursuance of the policy of meeting public requirements to the maximum extent but at the same time endeavouring to match efficiency with economy.

Whilst compliance with the first of these desiderata does not necessarily ensure complete achievement of the second, it is broadly true that the well being of a transport undertaking rests upon the degree of service it affords to its users and the relationship of service and price therefore remains one of the principal features in the minds of the commercial officers.

Ancillary services are an accepted part of British Railways, some being of long standing whilst others are of more recent origin to keep pace with needs as they become apparent, and expansion and development will continue. Most of them merit separate consideration and are reviewed below.

Collection and delivery services.

The Railways of Great Britain have, from their early days, undertaken the collection and delivery of freight traffic as an integral part of their overall service. For the higher-rated merchandise in the Classification (Classes 11-21) the chargeable rates are usually comprehensive and include the cartage element. If, however, the traders elect to collect and/or deliver with their own cartage equipment, an appropriate cartage rebate is allowed. Rates noted in the lower classes of the Classification (1-10) do not include the services of collection and delivery, but such traffic is carted by special arrangement and a supplementary charge is made for the service performed. British Railways do, in fact, cart substantial quantities of this type of traffic.

Initially horse-drawn vehicles were employed, and for many years the rail-

way cartage service was limited by a restricted range of operation and speed, but the advent of the internal combustion engine enabled the railways to overcome these restrictions. The motor vehicle widened the scope and increased the flexibility of collection and delivery services and the substitution of motor units and trailers for horse-drawn vehicles has been a matter of active policy for a number of years. At the end of 1952 the cartage equipment of British Railways consisted of :—

Rigid Motors and Tractors	5 388
Mechanical Horses and Articulated Motors	9 307
Trailers, all types	22 869
Horse-drawn Vehicles	8 415
Horses	2 068

Close study of the needs of the job in relation to the nature of the traffic and to the specialised mechanisation of goods stations, has led to the introduction and development of the most suitable types of equipment. Prominent in this respect is the mechanical horse, of which the railways were the pioneers, a petrol-powered unit, specially designed to act as its name implies — to attach and detach itself by simple means to the trailers or bodies standing alongside shed platforms until loading or unloading is completed. This avoids detaining the expensive power unit for lengthy and unremunerative periods as is the case with the orthodox motor lorry. The high degree of mobility and manœuvrability of such equipment is a great point in its favour when cramped or confined spaces are met with in the transport bays of some traders' premises or congested busy goods yards.

The point is being reached when, apart from the comparatively small number of horses remaining, miscellaneous traffic in the towns is dealt with almost entirely by mechanical horses or articulated units. On the other hand, traffic dealt with direct from or to rail wagons employs four or six-wheeled rigid vehicles to a large extent, although, here again, the articulated vehicle has its uses.

Vehicles employed for full wagon load traffic tend to be of a higher weight capacity.

The following are the types of equipment operated by British Railways :—

1. *Articulated.*

A. Mechanical Horse (petrol) (3-wheeled) used in conjunction with 2-wheeled superimposed trailers of capacities from 30-cwts. to 6-tons (See Fig. 1).

B. 4-wheeled petrol motive unit used with 2 wheeled trailers from 3 to 8 tons capacity.

C. 4-wheeled battery electric horse used with 2-wheeled trailers of 2½ tons capacity. This new development has a normal range of 25 miles for each battery charge, a maximum speed, when loaded and on the level, of 18 miles an hour.

(Trailers employed vary in design according to particular needs and include flat patform, full van body, three-quarter, half and quarter tilt, pole for timber, etc., float for glass in crates and cable drums. Some trailers are equipped for tipping, a power take-off being operated from the vehicle cab.)

2. *Rigid Type.*

A. *Petrol.*

Capacities range from 1 to 12 tons, the bulk between 2 and 8 tons. The vehicles are 4 or 6-wheeled and bodies are constructed to meet particular requirements, flat platform with fixed or hinged sides or with complete van bodies or tilts.

B. *Electric.*

Used in the main for parcels collection and delivery and fitted with full van body, capacities 1 to 2 tons.

C. *Diesel.*

A small number of medium heavy capacity rigid vehicles are in use, but the proportion of the diesel vehicle units is likely to increase in the future. Experiments with small-capacity vehicles are also contemplated.

3. *Tractors.*

These are 4-wheeled units and are used for hauling multiple wheeled trailers with capacities from 6 to 25 tons. The trailers are mainly of the flat platform type.

Fig. 1. — Mechanical Horse (petrol driven) (3 wheeled) used in conjunction with 2-wheeled, superimposed trailer.

In addition to the ordinary cartage services as such, further special facilities are provided for certain trades on request at a small fee, as, for instance, the cellaring of ale at licensed premises, the binning of flour for bakers and the decanting of oil at the garages or depots at time of delivery.

A special organisation exists for the cartage of abnormal indivisible loads, comprising such articles as constructional steelwork, boilers, transformers, etc. It also caters for the handling of such heavy articles from and to cartage vehicles and placing or uplifting them on or from specially prepared sites.

The service of cartage undertaken by British Railways by their own equipment or by the employment of Agents is no mean task; some 30 million tons of merchandise was so handled in 1952.

Zonal collection and delivery schemes.

With the object of reducing to a minimum the transit time and the handling of miscellaneous traffic, a system of zonal collection and delivery is in operation in most parts of the country. The scheme divides the country into a number of zones each containing a Zonal Centre station (or stations), railheads and sub-railheads.

A zonal station serves as the main concentration point in its zone and is connected by rail and/or trunk motor service with the railheads and sub-railheads within the zone.

A railhead maintains a service, by rail or road, with its sub-railheads for the conveyance of sundries traffic which is to be delivered, or has been collected, by the sub-railhead. It may also collect from, and deliver to, traders within the area.

A sub-railhead collects and delivers traffic in an area previously served by several stations, some of which may not formerly have enjoyed collection and delivery services.

By this concentration at a sub-railhead or railhead, miscellaneous traffic is cen-

tralised at one point instead of being distributed over a number of stations. Such concentration fosters direct wagon loading between main centres, thus reducing costly transhipment, transit time, and giving traders in outlying areas the benefit of a « main » station service. Each forwarding station endeavours to load direct to the station from which delivery of the consignment will be effected, or as near as possible to that point. Thus the forwarding stations order of preference, dictated by practicability is :—

(a) to sub-railhead, or railhead, performing delivery to consignee,
(b) to the Zonal Centre covering destination's railhead or sub-railhead,
(c) to its own Zonal Centre for forward loading either direct to destination sub-railhead, or railhead; or its Zonal Centre.

Whilst the scheme is designed and operated to cater for miscellaneous goods traffic, opportunity is also taken to afford collection and delivery service for such passenger parcels traffic as can be dealt with conveniently by zonal cartage units when this is the most suitable means of providing the service.

Railhead distribution and special cartage services.

A facility extensively used by large-scale distributors of such products as tobacco, cigarettes, confectionery, animal foodstuffs and fertilisers, is a rail delivery service over a wide area for bulk lots in full wagon loads from point of origin to a rail focal point.

Rates for bulk loads are charged to railhead centre, at which point the load is broken down and small lots, down to single packages, some of a few pounds weight, are delivered to a host of consignees over an area by railway cartage units at reasonable charges.

Another service with a rather different aspect is the delivery to site of special lots of traffic consigned in bulk to nearest suitable railhead and carted to location as required. For instance, local authorities or public works contractors laying pipelines may have the pipes delivered to the actual point at which each length will be laid, naturally a varying point with each load.

The aim of developing such cartage services as trade and industry may require is always in mind and the fact that an awkward or unusual cartage task can be performed to complete the job is frequently an attractive inducement to utilising rail transport.

Warehousing and storage.

At a large number of goods terminals, warehouse accommodation is provided as a customary feature of rail service. This is very valuable to traders on several counts. Some who purchase large lots of raw materials at times of peak availability or when favourable prices rule, may lack adequate storage space on their own premises and hesitate to incur capital expense on extensions for short intermittent periods. They welcome the facility of temporary accommodation which railway warehouses can offer, on a fixed space or tonnage basis, with handling and cartage facilities also available at need. Wool, cotton, grain, sugar, potatoes, paper, wood pulp and metals are commodities for which this service is extensively used.

Suppliers of such commodities as cement, cattle feed, fertilisers and flour, use railway warehouses as outposts of their own businesses and maintain bulk supplies there, which are delivered at need in small lots to consumers or local dealers.

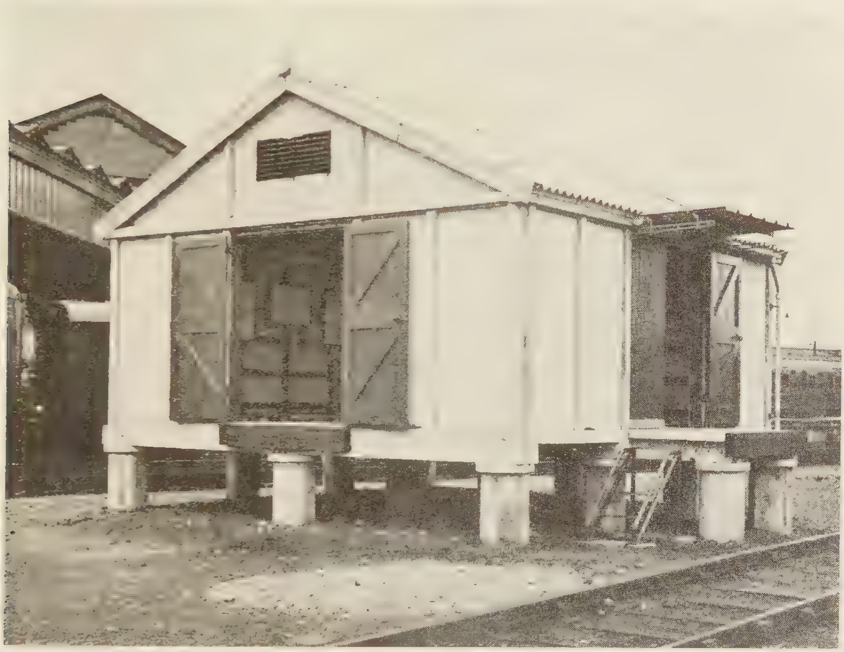


Fig. 2. — Prefabricated warehouse.

Railway staff undertake the necessary documentation including issues of sales notes, together with completion of traders' own delivery sheets, advices to suppliers and by furnishing weekly stock lists enable the seller to plan his forwardings to maintain ample stocks of a lengthy and diverse list of commodities.

Such services are being expanded to meet an increasing demand and where limitations could be imposed by lack of covered accommodation, particularly in rural areas, this is being met by the provision of a new prefabricated type of warehouse, built to standard sizes on sectional lines (see Fig. 2).

In addition to the normal warehousing of ordinary goods, there are, in the larger cities, railway « bonded » warehouses where dutiable goods, mainly wines, spirits and tobacco, can be held in store for owners under Customs or Inland Revenue Officer's supervision and released to the trade as duty is paid and documentary clearance effected with the revenue authorities. A variety of unusual services can be performed for the

trader by railway staff in bonds, including cooperage, vatting, racking, bottling and sampling at an appropriate scale of charges.

Indoor storage has its outside counterpart at most rail depots. The commonest form is coal stacking in station yards where it is customary for coal retailers to rent space, often connected to bunkers by plank walls, where coal is stored to provide reserves against emergency or working stocks from which household distribution is effected as necessary.

Other trades, in particular timber and building, store extensively in open yards to serve the needs of an area, or city, from « outpost » stocks, whilst many traffics of a rougher and less damageable nature are stored regularly or intermittently to meet special circumstances of the trades concerned, many of whom turn first to the local railway agent for assistance if their own normal space is over-crowded.

Sack hiring.

For many years, British Railways have afforded the facility of hiring sacks to farmers and corn merchants and this is recognised by the traders as a valuable adjunct to the industry. As the pressure of corn on the market at harvest time has progressively increased with the expansion of the modern technique of « combine » harvesting, the stock of sacks held by the railways has been raised and now stands at roughly 5 millions.

Container transport.

With the object of countering road competition, which expanded to a serious extent between the world wars, the railways of Great Britain pioneered the development of containers. Their advantages were soon recognised by the trading community and their popularity has continued to increase.

The container, which has been aptly described as « the suitcase of commerce », has many attractive features for the trader, including the elimination of intermediate handling of packages, minimisation of packing costs, and possibility of damage; by offering through conveyance — door to door (by use of crane transfer between rail and road vehicle) — from supplier to customer, often of a complete load of possibly scores of packages.

As with rolling stock a nice problem is presented of keeping the number of types to a minimum, for operating convenience and to achieve maximum flexibility of supply, and at the same time have sufficient types and sizes to cater for special requirements of particular traffics.

The present total stock of containers operated by British Railways, which is being progressively increased, is rather more than 25 000 in four groups - open, covered, special and bulk material types. Actual details of these are shewn in the table hereafter.

The open types are designed for commodities not liable to damage from weather conditions and are principally used for carrying bricks, slates, building materials generally, sanitary earthenware, and castings. The small « H » type, colloquially known as the « travelling hod » has the attractive quality of being eminently suitable for being craned, with

Type.		Tonnage capacity.	Stock at 31/12/52
OPEN (General Utility)			
Small	(H)	2 ½	4 015
Medium	(C)	3	1 194
Large	(D)	4	2 641
COVERED (General Utility)			
Small	(A)	3	4 793
Large	(BD)	4	6 267
Furniture	(BK)	4	1 637
Bicycle	(BC)	4 tons or 76 cycles	188
SPECIAL.			
Ventilated Meat	(BM)	4	584
Insulated Meat	(FM)	4	3 420
Highly Insulated	(AF)	3	376
Highly Insulated (Drikold)	(AX)	3	303
Highly Insulated	(BX)	7	1
BULK MATERIALS.			
Dolomite	(LD)	8	80
General Utility	(L)	4	1 ⌀
Cement	(LC)	3 ½	120
TOTAL.			25 620

⌀ 1 000 under construction — see reference page 462.

contents of bricks or tiles, from the delivery vehicle to the upper floors of buildings in process of construction to the actual point of use.

In the covered types the « A » and « B.D. » are general utility units suitable for a very wide range of general goods. By the addition of simple fittings they can be easily adapted to meet the individual requirements of certain traffics, such as confectionery, bread, machinery and refrigerators. A notable instance is the conversion by bars and hangers of a container to a « travelling wardrobe » in which coats and dresses for clothing firms can be carried in the same conditions as they would rest in the makers' show cases. The savings in packing, pressing and conditioning costs to the users are considerable. The « B.K. » is a large furniture removal unit; with interior securing slats, the « B.C. » is specially designed with rack fitments to offer safe transit for up to 76 bicycles — the racking equipment is easily removed which permits this type of container to be utilised for normal requirements during the off-peak season in the cycle industry (see Fig. 3).

Other types of containers include more elaborate units for definitely specialised requirements involving preservation of foodstuffs principally. For fresh meat, ventilated containers fitted with carcase

hooks in the roof are available. Insulated containers with hanging facilities, coupled with facilities for the use of wet or dry ice as a refrigerant, are employed to afford low temperature transport to the large-scale imports of chilled or frozen meat.

One of the principal lines of development in container construction at present is dictated by an increasing need for low temperature transport, due largely to the extending use of refrigeration and cold storage for foodstuffs and perishable commodities, e.g. ice cream, quick frozen fruit and vegetables are traffics for which this type is particularly suitable. The insulating efficiency of the containers has been specially studied and perfected by railway experts in close collaboration with the interested traders and Government Food Research Organizations.

Use of refrigerants in insulated containers is a further step in the direction of exercising temperature control in transit. The type and quantity of the refrigerant employed are determined by the nature of the traffic and temperature level necessary and to the probable duration of transit.

Fig. 3. — « B.C. » type container fitted with racks to convey up to 76 bicycles.

Solid carbon dioxide — dry ice — has been found the most suitable agent for general adoption after considerable research, backed by experiments. Dry ice, suspended in cartons or nets above the load, or broken and distributed over it, can, in conjunction with a 9 inch thickness of insulation in the container walls, maintain a transit temperature at or below 0°F. As an alternative, containers can be fitted with eutectic plate equipment enabling the trader with requisite compressing plant to precool the

containers with a suitable freezing gas (see Fig. 4).

Where the provision of dry ice is made by the railways, a small charge is made for the refrigerant and servicing of the container. The transport of the dry ice itself from the makers' factories to the railhead depots they maintain has called for a special container which, with 10″ of insulation throughout, enables a transit temperature to be maintained at the low level of —110°F. (see Fig. 5).

Traffic in containers is normally charged on a net weight basis, with a minimum of 1-ton per container, with a differential over the normal chargeable rate.

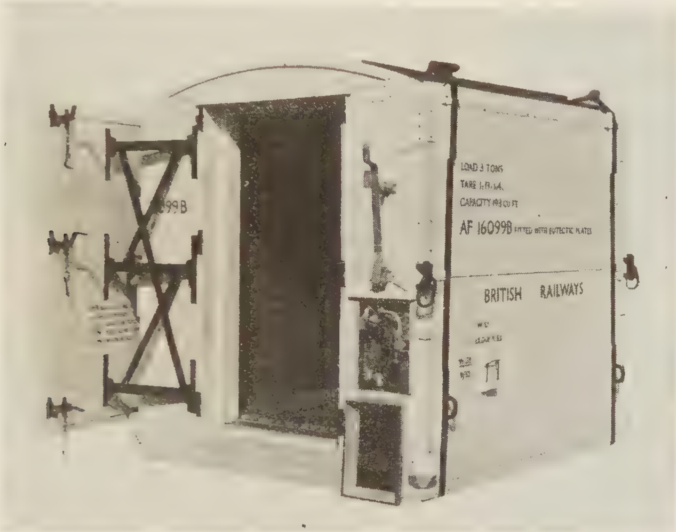


Fig. 4. — « A.F. » highly insulated container fitted with eutectic plates.

Liquids in bulk.

The movement of liquids in bulk has made considerable progress in recent years. The tendency to avoid the many restrictive features of small unit packaging, with its high cost in casks and drums, storage space required therefore, and cost and inconvenience involved in the return of empties, has led traders to look with marked approval on the advantageous facilities for bulk movement of specific traffics placed at their disposal by British Railways.

The trader is relieved of the need to incur capital cost by the Railways' undertaking to construct tank equipment to his particular design and requirements, and to hire such equipment to him under agreement, at attractive annual rentals for a minimum number of years. Some firms, of course, prefer to own their tanks outright. Special linings of stainless steel, glass, or enamel, can be incorporated with effective insulation at need. Pro-

Fig. 5. — Highly insulated container for conveying dry ice.

vision can be made for heating during transit, if necessary, and pumps fitted to effect discharge at terminals. The rail chassis being fitted with vacuum brakes, can obtain the advantage of express train services and so secure speedy transits.

Hire terms are also arranged for rail chassis only in those cases where traders prefer to use their own tanks.

Equipment furnished by British Railways is in three main types :—

(a) *Fixed rail tank vehicles.* Designed for use solely between rail-connected terminal points, these high-capacity tanks are built on to special rail chassis. They can be discharged by gravity or by pump. Present types in use range from 2 000 to 10 000 gallon capacity (see Fig. 6).

(b) *Demountable tanks (non-wheeled).* For non-rail-connected premises, tanks designed for cranage between rail chassis and cartage unit are provided. To bring them within the scope of normal cranage and cartage equipment, their capacity is usually limited to 1 000 gallons, with a gross weight of 6 tons. Collection from sender's premises and delivery to consignee is by road motor, and discharge can be effected to plant or storage by such means as consignee may normally employ. Up to four of these tanks can be carried on one rail vehicle (see Fig. 7).

(c) *Road-rail tanks (wheeled).* A variant of the type of tank required for work between non-rail-connected premises is a tank fitted with two or four rubber tyred wheels. At the end of a rail transit it is drawn from chassis over an end loading dock by mechanical horse or motor tractor according to the type of equipment and hauled to destination. Rail chassis are available to accommodate one or two of such tanks.

Carriage charges are raised only on the actual weight of tank contents and the tank is given free return transit. Thus the hirer receives favourable charging treatment and can be assured of the exclusive use of this equipment.

The range of liquids carried is

Fig. 6. — Fixed rail tanks.

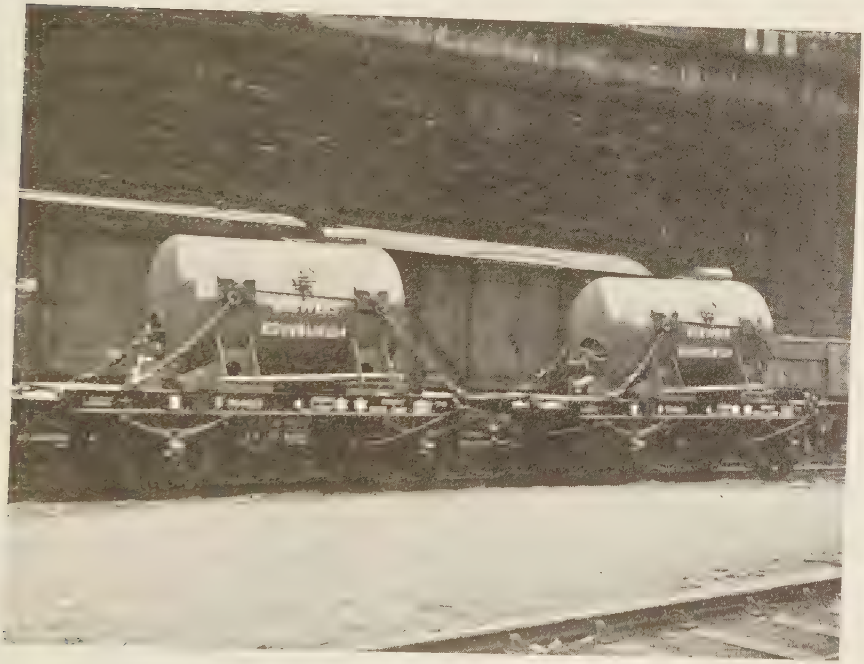


Fig. 7. — Demountable tanks (non wheeled).

extensive and increases every year. Principal industries which have found the service of value to them are dairy, brewing and distilling, paint and varnish, chemicals, printing, solvents and tanning.

Commodities in bulk.

In many industries today the tendency is towards reducing manual handling and the substitution of mechanical methods with the joint aim of cutting costs and speeding productivity. In consequence a wider range of granulated, powdered and similar commodities, also certain specific solid traffics, now move in bulk, a tendency which also received impetus from the difficulty in recent years associated with the cost and scarcity of packaging material.

Where traffics move in bulk between rail-connected installations little difficulty exists in loading by gravity, and discharging by gravity or suction from railway vehicles. Special hoppered wagons are utilised extensively in the coal, ore, limestone, grain and chemical industries.

Where these facilities do not meet the situation, e.g. non rail-connected premises there is a developing tendency to employ road transport for bulk conveyance with specialised types of equipment. British Railways realized that new methods were demanded for these commodities for which cartage is required in addition to rail conveyance, but presented a problem in the methods of transferring from rail wagon to cartage unit and vice versa. With this in view, a new type of bulk drop unit or container has been evolved and 1 000 are now in process of construction. This embodies improvements on existing types for carrying cement and was designed for that and similar traffic — ground limestone, fluorspar, dolomite, alumina. Its use will eliminate bags, sacks and costly manual handling. (See Fig. 8.)

Fig. 8. — Bulk drop container, used for conveying cement, ground limestone, etc.

Loading is by gravity through the top hatch of the container, the cover of which is secured by a simple sliding lid, designed to minimise headroom. Its capacity is 4 tons — 90 cubic feet — in two compartments, watertight under the worst weather conditions, and when

lifted by crane it can discharge contents of both, or either, compartments by bottom doors on pulling a lever. Its weight, loaded, is within the capacity of most station cranes and cartage units and by travelling three to a wagon can give a pay load up to 12 tons per wagon.

The problem of carrying tarred roadstone, used extensively in road repair and construction work today was complicated by the protracted and costly operation of discharging out of a rail wagon to the road vehicle delivering to site. This was solved by the provision of a rail vehicle chassis carrying four 3-ton capacity demountable steel skips. When craned off by mobile or fixed station crane, employing special lifting bar, the skips, being lifted by trunnions set below the centre of gravity, are overturned, and discharged into the waiting road lorry by the simple act of disengaging a retaining catch. By this means four skips are released in 14 minutes, i.e. a 12-ton load which would take several hours to discharge manually. (See Fig. 9.)

Close watch is kept by the railways on the trend of further developments in industry generally with the view to securing traffic in bulk by supplying such equipment as the result of study of the particular problem demands.

Fig. 9. — Demountable steel skips for conveyance of tarred roadstone.

Packaging and damage vulnerability.

The highly miscellaneous character of the majority of sundries traffic passing by railway, and the special vulnerability to damage of some, whether in odd lots or regular streams, has necessitated constant vigilance and the evolution of special measures to keep the damage factor to a minimum.

In close collaboration with all trades concerned and with recognised authori-

ties on packaging methods and standards, they maintain a Central Packaging Bureau for the dissemination of advice to traders and undertake the testing and approval of a wide range of styles and types of packing for the most diverse range of merchandise.

Changes in trends of packing methods and developments in new materials, dictated by variations in the availability of slides and rubber springs. Their use for specialised flows of traffic, including spun pipes, castings, earthenware, glass bottles and sanitary goods, has made an appreciable contribution to the elimination of transit breakages. Covered vans built on the same principle have since been introduced, with marked success on particular traffic flows such as radio valves, wireless sets, vacuum flasks, etc.

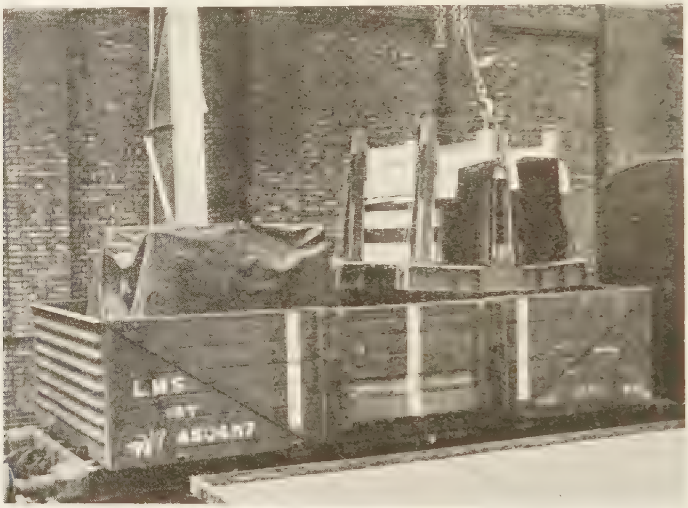


Fig. 10. — Glass cradle with detachable sides.

and cost of traditional packing materials, are studied and new techniques are examined exhaustively and given practical tests for efficacy under severe conditions.

In regard to their own equipment, the railways have studied problems associated with unavoidable transit shocks, and a most noteworthy achievement has been the introduction of shock-absorbing wagons which permit of longitudinal body movement on the chassis by means

Several individual traffics posing problems particularly their own have been tackled independently. Notable amongst these is sheet glass, which has always presented difficulties to packers and carriers by reason of its size and fragility.

Post-war demand for glass was enormous, the requirements of London alone being estimated at 18 000 tons per year. Timber for packing crates was scarce and expensive and labour costs heavy. Some method had to be devised to offer

a safe transit with the minimum of packing.

In conjunction with the principal senders, the railways designed special glass cradles in the form of felt lined stillages of inverted T shape with detachable sides capable of adjustment to exert any required pressure on the pack of sheets of glass in either half. With a capacity of 4 1/2 tons, the cradles when packed at works can be lifted from road vehicles to rail shock-absorbing wagon (if not loaded at Private Siding) and after transit are similarly craned off to delivery motor. Consequently no handling of the sheets is necessary until transit is completed and final delivery is effected. (See Fig 10.)

Fig. 11. — 56 wheeled cantilever wagon set.

Exceptional loads.

In addition to the millions of consignments handed to the railways every year for transport in the ordinary way in standard vehicles, there are a substantial number of loads carried which, by reason of size, weight, shape or other unusual features, necessitate careful advance planning, provision of special vehicles and arrangement of special services.

Many of these are « out of gauge » loads projecting beyond the safe permitted limit on one or both sides of the truck, so that special routing of the train may be necessary and, often, special weekend running. Frequently these transits, arranged in conjunction with the engineer, require the temporary removal of lineside obstacles to permit their passage.

For their transport special vehicles are frequently in demand. High carrying capacity well wagons, flat trollies and bogie bolster wagons are available for such work and, for the heaviest loads, a giant 56-wheel cantilever wagon set capable of carrying 150 tons, is brought into service. (See Fig. 11.)

Modern industry, conscious of trans-

port limitations, is careful to confine its output to pieces of moveable size, but, to an increasing extent, the limits are mounting and some indivisible loads of such kind as ships' propellers, electric generators, stators and transformers, and oil refinery tanks and towers, are being produced to a scale which taxes the resources of transport to the full. The accompanying photograph (see Fig. 12) illustrates a cataclyst storage drum 60′ long, 16′ 6″ in diameter and weighing 38-tons, in transit.

Fig. 12. — Cataclyst storage drum in transit by British Railways.

Special requirements of normal traffics.

Many traffics that may be classed as normal, present certain features that demand special treatment. Simple examples are bananas, which require steam heating of the wagons in which they are carried from ports to inland markets, or fruit from English orchards which, to preserve their « bloom » and freshness, benefit from forced draught ventilation of their vehicles or wire mesh shelving which permits heavier loading without crushing of lower tiers.

An extensive livestock traffic has special features all its own. Roughly five million heads are carried every year, mainly cattle, sheep, pigs and horses. Special livestock vehicles are employed and the best and speediest possible services are given to minimise transit times. When the transit time exceeds a certain limit, variable according to the type of animal, feeding and watering must be performed, and with milch cattle milking is essential as and when due to avoid suffering or distress. Railway staff undertake all these services as a matter of routine, either at recognised stops for livestock trains or at the nearest staffed halting point in emergency.

Careful watch must be maintained on all animals in transit to note evidence of distress or injury and permit the appropriate remedial action dictated by the circumstances.

Strict Government regulations govern the procedure to be adopted in cases of outbreak of Foot and Mouth Disease or Swine Fever or other diseases and their rigid observance is a further responsibility placed upon railway staff.

At certain West Coast ports a considerable number of animals is landed from railway owned steamers and arrangements are made for the animals to spend statutory resting periods in railway lairages before onward transit. Railway staff, too, under veterinary supervision, perform such services as ear-tagging and tattoo marking with date of importation, in addition to feeding and watering in the ordinary course.

Dangerous goods.

Whilst British Railways are not common carriers of dangerous goods, they do in actual practice carry a large tonnage of a very wide range of traffics covered by that definition, but only on the signed acceptance by senders of certain special conditions.

In view of the widespread growth of the oil, petroleum, chemicals and other industries, the tonnage of dangerous commodities now passing is considerable and their classification most extensive.

A high proportion passes in Owners' Tank Wagons under stringent operating safeguards, whilst smaller lots in carboys, drums or cases complying with very carefully conceived specifications, are handled over goods station decks with adequate precautions against damage or against contamination of other traffics.

Explosives, which may not be handled except within the hours of daylight, are generally carried in special locked gunpowder vans apart from all other commodities, and the entire arrangements for their movement are governed by very strict Government regulations.

Distinctive labels are used for all vehicles carrying dangerous, inflammable or explosives traffic, and in certain cases regulations provide for limitations of the number permitted to be conveyed on any one train and in regard to their position in the marshalled order.

Farm and works removals.

Commercial contact with the agricultural community frequently produces information of impending removals of owners or tenants from one farm to another. Opportunity is sought to quote for the entire removal on a special train basis, and often with success.

On the agreed date a special train of an odd appearance and mixed character is loaded and worked through to destination. The farmer, his family and staff travel in a passenger coach, the livestock and poultry in suitable vehicles, and the stock of implements on flat wagons with furniture and personal effects in specially fitted furniture containers. If required, crops, fodder, etc., form part of the removal.

Everything is planned in advance, and the feeding, watering and milking of animals is carried out en route when necessary.

Facilities are available for removal of works or factories, which with their stocks and plant often provide large-scale operations with problems of weight, bulk and movement prior to loading of the train, for which all the resources of the railways can be mobilised at need.

Fig. 13. — A rail-connected shipping berth.

Shows and exhibitions.

The many national shows for industry and the provincial agricultural shows that are held in every county are rightly regarded as the shop windows of the many sponsoring industries and allied trades who serve them.

It is customary for British Railways to provide their own inquiry bureau, and to arrange representation by expert personnel equipped and ready to assist any exhibitor or customer on any branch of rail transport, either concerning the movement of his exhibits or any phase of his business generally.

With shows of the larger calibre — British Industries Fair or the Royal Agricultural Society of England Annual Show — the staff work involved in preparation for the event so far as railway assistance is concerned is extensive and the services afforded are greatly appreciated by exhibitors.

Shipping services.

The insular position of Great Britain, close to the northwest seaboard of the Continent of Europe, and her economic position as one of the world's greatest

importing and exporting nations, has given her railways special responsibilities and opportunities alike in respect of trade with her nearer neighbours and, through the ocean ports, with the farthest corners of the globe.

British Railways are in a position to carry export traffic right to the quay alongside ship (see Fig. 13), and in the reverse direction to pick up import traffic at the same point for movement inland. To assist the many trades involved, they maintain at the principal ports a specialised organisation, staffed by experts, to act as agents for traders by clearing their wares through the Customs and clearing bills of lading with the shipping companies, in addition to offering the fullest current information at any time in regard to the movement and berthing of vessels, opening and closing dates of loading.

Trade with Britain's nearer neighbours is served even more closely by the connection maintained by the railways with their own vessels to the Continental ports, Channel Isles, Northern Ireland and Republic of Ireland. Out of a total fleet of 133 vessels, 75 with a net Register tonnage of 67 000 tons, are operating throughout the year on Continental, cross-Channel and Irish services. From 8 East and South Coast ports to 15 ports between Copenhagen and St. Malo, regular services are maintained. Ireland is served by steamers operating the Holyhead-Dublin, Heysham-Belfast, Fishguard-Rosslare and Waterford and Stranraer and Larne routes.

The 75 ships engaged on the Continental, cross-Channel and Irish Services conveyed in 1952 some 1 500 000 tons of merchandise and 211 000 heads of livestock in addition to the extensive passenger and motor car carryings on the mail and other steamers.

One feature of these services merits special mention, e.g. the train-ferries operating between Dover-Dunkirk and Harwich - Zeebrugge. Specially constructed ferry wagons can work through between British stations and destinations in the majority of Continental countries, with distinct advantage, which traders have been quick to realize, in that transhipment and intermediate handling is entirely eliminated, risk of loss or damage minimised, and speedier throughout transits.

The import of fruit and vegetable traffic is materially assisted by this service, as is anything of a perishable nature. For the more vulnerable of these traffics refrigerated or insulated vehicles are used, provided by the well-known Interfrigo Company, with which British Railways are associated.

Recently railway history was made when a consignment of fruit from Spain to the West Coast of Scotland passed direct in a wagon which, by reason of interchangeable axles for crossing the Franco-Spanish frontier, and use of the train ferry, had its contents entirely undisturbed throughout the journey.

An extensive livestock traffic passes from Ireland to England, and during the peak autumn season cargo vessels specially equipped for the conveyance of animals carry full loads into Heysham from Northern Ireland.

The container service of British Railways is also available to adjacent coun-

tries and an appreciable number are shipped weekly, mainly to Ireland, from British ports by British Railways steamers, some of which are used exclusively for this purpose.

This container service has met with a lively response from the trading community and with the growing demand, British Railways are planning a general expansion in their Irish shipping facilities.

Container facilities are also available by British Railways steamers to the Continent and Channel Islands.

Commercial research.

Research on British Railways is regarded as an essential adjunct to efficient management, and technical and scientific specialists carry out a wide range of laboratory and field work on behalf of all departments.

In addition, the Commercial Member of the Railway Executive and his commercial officers have at their disposal a bureau of non-technical staff who study and report on any problem of a purely departmental nature which warrants investigation. Their principal activities are consideration of domestic methods of operation in the commercial department's field and of the changing trends in outside industry which may necessitate a revision or re-alignment of any of the commercial services afforded by the railway.

The foregoing survey, brief and incomplete though it may be, serves to show that freight traffic on British Railways, in common with all other rail undertakings, is not the spectacular side of the industry. Youthful train spotters find little to catch their imagination, but twenty-four hours daily, the freight system plays an outstanding part on the busiest transport undertaking in the world in the vital economic life of the country, and British Railways confidently look ahead to affording further improved freight services and facilities with the relaxation of national financial restrictions.

[625 .17]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th. SESSION (LONDON, 1954).

QUESTION 1.

What are the present tendencies relating to the organization of the maintenance of the permanent way : methods of determination of the works to be done and in particular, possibilities of the use of detecting-recording coaches, planning of the works, effects of mechanization; importance of the side-tracks for the movement of the gangs and the mechanical devices.

Economic and financial aspect.

REPORT

(America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible),

by O. Hjelte CLAUSSEN,

Permanent Way Engineer, Danish State Railways.

Thirty-seven Administrations were consulted.

Replies have been received from the following 14 Administrations before June the 15th :

- Association of American Railroads;
- British Railways;
- Ceylon Government Railway;
- Coras Iompair Eireann;
- Danish State Railways;
- East African Railways;
- Egyptian State Railways;
- Finnish State Railways;
- London Transport Executive;
- Nora Bergslagen Railway;
- Rhodesia Railways;
- South African Railways;
- Sudan Railways, and
- Swedish State Railways.

In the present report an extract is given of the answers to each question, supplemented now and then by typical answers or information of special interest from the Railway Administrations concerned.

The Railway Administrations from which answers for this report have been received are scattered over most of the world. A whole series of circumstances, which are highly important for maintenance of way organisation — such as for instance climate, geological circumstances, density of population and not least the social and economical living standard — vary so much from place to place that a comparative statistical estimate of the maintenance methods of the different countries and of their results is quite impossible based

on the information received (concerning p.e. length of lines and traffic).

Some of the railways in question have apparently been aware of this and have answered consequently.

I. — WHAT ARE THE PRESENT TENDENCIES RELATING TO THE ORGANIZATION OF THE MAINTENANCE OF THE PERMANENT WAY.

By « maintenance » must be understood the whole of the operations intended to keep the track in a good state of repair between two complete relayings, as regards safety and comfort, corresponding to the needs of the line in question.

A. — Statistical data concerning the extent of the railway system from the point of view of the permanent way.

1. *Complete the following table by giving the length in kilometres of the railway system you have to maintain :*

   a) *length of the main tracks on single track lines;*

   b) *length of the main tracks on double track lines;*

   c) *length of the main tracks on lines of more than 2 tracks;*

   d) *total length of the main tracks* (a + b + c);

   e) *length of all other tracks;*

   f) *total number of units of points and crossings.*

By « units relating to points and crossings » the following is meant :

1 turnout-crossing with 2 tracks = 1 unit
1 turnout-crossing with 3 tracks = 2 units
1 single slip switch crossing . . = 2 units
1 double slip switch crossing . = 4 units
1 ordinary crossing . . . . . . = 1 unit

2. *To enable comparisons to be made and the whole extent of a railway system to be expressed by a single figure, the lengths of all the tracks other than main tracks, are calculated at 0.3 km per kilometre and the points and crossing unit at 0.1 km of track are counted. The equivalent total length of the system from the above table will be :*

$$d + 0.3\,e + 0.1\,f.$$

3. *What is the annual traffic of your railway in gross trailing-ton-kilometres (T. K. B. R.)? (This must be taken to include the gross ton-kilometres of all trains excluding the weight of the locomotives.)*

In the following table is shown the result of the replies received :

	2. « Length »	3. T.K.B.R.
British Railways	80 279	—
Ceylon Government Railway	1 779	—
Coras Iompair Eireann	2 997	—
Danish State Railways	4 871	7 725 000 000
Egyptian State Railways	6 030	8 200 000 000
Finnish State Railways	6 545	—
London Transport Executive	966	—
Nora Bergslagen Railway	220	82 000 000
Rhodesia Railways	2 464	10 093 000 000
South African Railways	25 710	65 357 000 000
Sudan Railways	3 585	—
Swedish State Railways	17 051	33 091 000 000

B. — **Regional organization.**

1. *Influence of the general inspection of the lines :*

a) *are the maintenance gangs responsible for providing keepers at the level crossings?*

In most African and some Scandinavian countries, these keepers do not concern the maintenance gangs. In different other countries the gangs are responsible for providing keepers in the majority of cases, but these keepers are exclusively occupied by this work. In the U. S. these positions are frequently filled by disabled employees of the maintenance of way or operating departments.

The gangmen generally replace the keepers for rest days, holidays, and in cases of illness.

b) *what other supervisory obligations fall upon the maintenance gangs (inspection tours, etc.)?*

In most countries, track inspections are made almost daily by the maintenance forces.

Upon the maintenance gang depend :

Fog signalling duties, provision of look out men, hand-signalmen, and on occasions pilotmen in the U. K., and protection of work done under contract as well as supervisors by important track work in Denmark.

Apart from these supervisory obligations many different duties other than routine track maintenance work fall on the gangs varying much from country to country.

c) *how do these obligations affect the geographical organization of your gangs?*

In most cases, these obligations have no effect on the geographical organization of the gangs, but where the foregoing duties are heavy, they are naturally reflected in the size and make up of the gang organization and the territory assigned.

The lack of supervisory obligations in some countries gives the gangs a greater mobility. The gangs can be used on lines where they do not know the local conditions.

d) *do you have various types of organization corresponding to the greater of lesser importance of their supervisory obligations (lines with very heavy traffic, lines with very little traffic, mountain lines, etc.)?*

Only the American, the British and the Rhodesia Railways report of various types of organization.

The basis of British Railways' maintenance organization is the small length gang. In addition, there are in country areas on branch lines a relatively limited number of larger gangs provided with power driven trolleys or road vehicles, who are responsible for longer lengths of line.

Also on the Rhodesia Railways some branch lines are maintained by motor trolley gangs.

e) *can you characterize such organizations according to the relative number of men days spent on supervisory duties?*

In the U. S. the average section gang during summer working season usually includes 1 foreman and from 4 to 8 men.

District gangs, covering a number of sections for heavy work, usually include the foreman, an assistant foreman, and approximately 20 men.

f) *do the supervisory requirements make it necessary for you to house the men at points along the line?*

In many of the countries concerned it is necessary to house the track inspection personnel at points along the line (on some occasions these houses are used by the crossing keepers).

2. *Influence of geographical conditions :*

a) *do housing difficulties make it necessary for you to group the men into gangs working at times at a distance from their homes ?*

Generally, it is not necessary.

In the U. S. housing shortages along the line sometimes require that gangs be housed at specific points, usually in the larger communities, and transported daily to the scene of work by motor car and trailer or by highway truck, sometimes as much as 25 or 30 miles. Shortages of labour also require, in some instances, that labourers be moved many miles from one part of the country to another, largely to accomplish seasonal work. For example, a considerable amount of coloured labour used for heavy maintenance programs on at least some northern roads during the summer, comes from the southern part of the country, and returns back south in the winter. This temporary labour is usually housed by the railroad involved in permanent camp buildings or camp car outfits. Furthermore, large district or system gangs assembled for such operations as rail laying, ballasting and surfacing, are frequently moved from one district to another, and are housed in camp car outfits — being taken to and from the site of work daily in trucks or busses, or on motor cars and trailers.

In East Africa, the « houses » of African track labour are in the native reserves, usually far from the railway. Housing is provided for gangs at 4 miles interval approximately where Africans can live with their families. Time and again, they take leave to visit their homes in the reserves.

b) *the men may go from their homes to work on foot, by bicycle, motor cycle, lorry track or by train. Can you give in each case the approximate percentage throughout the year of men using each of the above methods of transport ?*

The way the men go from their homes to work vary very much.

In the U. S., trackmen usually come to the toolhouse in their own automobiles, or on foot if close enough.

They leave their automobiles there to be used in returning to their homes at night.

In Africa, most trackmen go on foot, except on some desert lines where they use motor-trolleys.

In Europe :

on foot from	10-25 %
on bicycle from	10-90 %
on train from	0-30 %
on motor-trolley from . . .	0-50 %

c) *when a gang frequently has to work a long way from home, do you have to reduce their working hours or pay additional wages ?*

Gangs usually work an eight-hour day, from the time they leave the toolhouse until the time they return. If their scene of work is a long way from the toolhouse, their productive working hours are reduced. If for any reason gangs work more than their eight hours in order to increase their productive time on the job, their wages are increased.

In the case of men working away from their normal gang length, a special allowance is paid in many countries.

d) *what is the average number over the year of men able to have their midday meal at home ?*

On American Railroads, practically no maintenance of way workers have an opportunity to eat their midday meal at home.

On Ceylon Railways, only 5 % eat at home.

In East Africa, the gangers eat before work and after work and rarely have a midday meal. In other African railways, the percentage vary from 0 to 50 %, and in Europe from 0 to 30 %.

3. *Influence of the equipment :*

a) *has the influence of above two factors been preponderant in determining the present organization of your gangs and has it led to choose methods of maintenance depending upon the use :*

— *of hand tools* . . . — *used individually by gangs of average size;*

— *of motors and motorised equipment* . . . . . — *used by large gangs ?*

Ordinarily, the present organization of the gangs has not been influenced by the above two factors.

In many of the countries concerned the basis of the maintenance organization is the small length gang, which is responsible for inspection and maintenance of a given length of track. From its very nature these gangs cannot be highly mechanised.

Also often the type of labour used favours the use of hand tools.

b) *have you any new methods of organization under trials, and what were the chief motives for making such trials ?*

How do you reconcile them with supervisory and geographical problems ?

c) *do these trials cover long sections ?*

d) *how long have they been going on ?*

By the American railroads, new methods and organizations are constantly under trial to meet special conditions or to reduce maintenance costs.

One of the basic trends in maintenance of way organizations in recent years, due primarily to the inauguration of the 40-hr. week, higher wage rates, and the development of power machines and tools, has been the lengthening of section-gang territories, and the organization of extra gangs or district gangs to do the heavier outface work on these territories, leaving only the lighter routine maintenance jobs to the section gangs.

One railroad, going still further, has reorganized the section forces on a large portion of its lines under a plan wherein it has combined former small section gangs into larger district gangs and has extended the territories to be maintained. A report on the plan developed by this railway, which was made in 1951, brings out the following facts.

The first district gang was established in 1947 to supplement the work of section gangs on a 39-mile section of double track, Four of the nine section gangs working prior to the change were eliminated and the territories of the remaining five sections were extended. When the first district gang was inaugurated it was intended that this gang would be used as a supplementary force, without a patrol unit, and without complete responsibility for any particular section of track.

This gang, under one foreman, handled the heavier and out-of-face jobs, while the remaining section gangs continued to do the lighter and minor work. The plan was so successful that additional district gangs were set up, and at the end of 1951, 68 such gangs had been established.

Consideration was then given to the possibility of eliminating all small section gangs on the roadmaster's territory and establishing district gangs, with a patrol unit included, assigned the entire responsibility of a definite section of track. Such an arrangement was put into effect on July 1, 1950, on a specific section of that railroad, and as of July 1, 1951, 13 of the 36 roadmasters' territories were so organized. On four of the 13 territories, one small section gang was left to maintain either a branch line or a terminal.

District gangs, on this railroad under

both classifications mentioned above, should be differentiated from extra gangs, in that a district gang has permanent headquarters and is not assigned outfit cars.

When the plan of using district gangs was on this road in 1947, it had a total of 1873 section labourers working six days a week on 602 sections. By the end of 1951, it was working 1 753 labourers five days a week on 185 sections and in 90 district gangs. Forty-eight of the district gangs supplemented the work of section gangs, and 42, with an assistant foreman and a patrol unit, were assigned exclusive responsibility for a definite section of track. The supervisory force under the new arrangement totalled 317 men, compared with 602 in 1947.

The work of the district gangs is planned and organized to permit the major part of the force to work almost continuously on constructive work. The assistant gang foreman with one or more labourers as required, patrols track, does some minor spotting, and generally handles miscellaneous work formerly done by the small section crews. This leaves the district gang foreman and a sizeable crew free to handle out-of-face surfacing, tie renewals, and short stretches of out-of-face rail relays. With this organization, the use of small extra gangs is decreasing, as the district gangs are able to accomplish more and more of the work that was formerly handled by these small extra gangs.

In emergencies, such as derailments, washouts, etc., several district gangs, with trucks available for transportation, can be called to make repairs. In this manner, a sizeable working crew of experienced workers can be assembled in a very short time.

In 1950, the railroad concerned renewed almost as many sleepers, laid more rail, and ballasted and surfaced 45 % more track than in 1947, and did it with 17 % less man-hours.

It should be borne in mind that the road referred to above operates in a territory that does not experience severe winter weather. It has been the general experience of the American railroads that, in northern climates, subject to snow and ice conditions, it is impracticable to eliminate section gangs, and, on the other hand, impracticable to work large mechanized district gangs effectively, in the winter, in productive maintenance work.

Another railway, which has lengthened track sections appreciably in recent years, is now experimenting in a limited way, on a light-traffic line, with the elimination of all section forces, and the substitution therefore of a few extra gangs of 15 or 16 men each housed in camp cars, and supplied with highway motor trucks for transportation to and from the site of daily work. The use of highway trucks in this instance is facilitated by the fact that, throughout the territory, there is a highway close to the track. The purpose in this reorganization is to reduce labour costs through mechanizing the extra gangs, which cannot be done to the same extent with the smaller section gangs. In fact, to gain the most from machines used by the extra gangs, it is contemplated that certain of them will be used two shifts daily.

Another road has developed and uses extensively what is termed the « Detour Method » of track maintenance. Under this method the track, for a length of about five miles between temporary or permanent crossovers, is taken out of service and given over to the exclusive use of a track gang of some 140 to 150 men for the eight-hour work period each day. All work within the five-mile stretch is completed before taking another section of track out of service.

The work performed during the detour operation included renewing ties, raising and surfacing track, spot tamping, gauging, changing joint bars where necessary, building up rails ends by welding, grinding battered rail ends, resetting rail anchors and unloading and equalizing ballast. Of course, such a gang would also carry out any rail renewal work which might be involved.

The heavy work of these detour gangs is supplemented by skeleton section crews which do the routine inspection and minor maintenance operations.

The following table shows an example of the man-hours required for doing work on one mile of track by the detour method as compared with the use of the smaller gangs working under traffic :

	Detour method hours	*Small gangs under traffic* hours
Foremen	180	192
Asst. foremen	140	478
Labourers	2 500	6 220
Repairmen	100	70
Ass. repairmen	40	70
Repairmen helper	20	
Work train	26	
Detour conductor	20	24
Detour brakemen	20	
Proportion of cross-over : Foremen	3	
Labourers	64	
Total	3 113	7 054

Shortage of man power in certain areas coupled with economic reasons has also led the British Railways since 1950 to experiment with mobile mechanized gangs. This trial is now extended to 5 sections of 80 km (50 miles) each.

The Danish State Railways are now starting on trial mobile gangs for larger maintenance work (incl. levelling by measured shovel packing), but leaving all daily work to a reduced small length gang.

In 1951, London Transport started experimenting by the amalgamation of 3 small section gangs each of which previously maintained 1 1 2 miles of double track, and forming these men into 2 gangs. The total number of men then reduced by 10 % due to the reduction in the number of gangs and thereby in the amount of time spent in preparing materials, cleaning the cabin and charging and repairing tools. One of the two gangs was twice as large in number as the other, and this gang in responsible for the main fettling work. The second and smaller gang is responsible for goods yard maintenance, point oiling, insulator changing, bolt tightening, etc. The primary reason for initiating this experiment was shortage of staff, and the secondary reason was to obtain a greater measure of control over the major work of the section men, which was fettling track.

When using mechanical maintenance equipment from time to time in short length gangs some railways often have these machines operated by local gang men improperly qualified or insufficiently trained to get the maximum production from a machine and minimize the amount of repair service required.

When once a machine operator has been qualified and assigned to a machine he should remain with that unit as long as it continues to be in use, regardless of where it works.

Under conditions existing on the railways, the machines may be widely separated, thus making direct and frequent supervision difficult. Achievement of the maximum return from the machine rests on the shoulders of the operator. Therefore it is highly important that the operator is well trained.

Several U. S. railroads have a definite programme for training and qualifying power maintenance equipment operators, and it is regarded as essential if operating and maintenance costs of the machines are to be kept to the minimum to have such a training for operators.

4. *Mechanization index figure :*

If the mechanization characteristic of an organization can be given by the ratio :

$$\frac{\textit{Total power in HP of all the motors or tools available}}{\textit{average number of men}}$$

please give this ratio :

a) *for your railway as a whole?*

b) *for the section of your railway where mechanization is most highly developed.*

Few answers have been received :

British Railways : *b*) 1.2;

Coras Iompair Eireann : *a*) 0.012;

Danish State Railways (*) : *a*) 0.8;

Swedish State Railways (*): *a*) 1.3, *b*) 2.0.

As an indication of the extensive use of power tools and machines by the maintenance forces on American railroads, it is reported that in 1952 these railroads purchased a total of approximately 8 000 units of power equipment and tools of all types for use in the maintenance and construction of their tracks and structures, at an estimated total cost of $ 20 700 000 (from 1937-1952, 124 000 units).

II. — METHOD OF DETERMINING THE WORK TO BE DONE. POSSIBILITY OF USING RECORDING VEHICLES.

A. — Classification of the lines.

1. *How do you determine :*

a) *the permanent way equipment?*

b) *the number of men required for maintenance?*

Is this done in terms :

— *of the kind of trains (predodominantly passenger or goods)?*

— *of their speed?*

— *of their number (daily tonnage);*

— *of the maximum axle load (of wagons or locomotives)?*

(*) Incl. motor-driven vehicles.

2. *Does your classification of the lines depend on the above data or do you base it upon other characteristics?*

The permanent way equipment (track, sleepers, ballast, etc.) is generally determined by speed, traffic density and maximum axle load.

Many different factors can be taken into account to determine the number of men required for maintenance.

It depends upon the amount and character of the work to be done, kilometres of track, the amount of money available, the geographical conditions, such as curvature, grades, stability of the roadbed, etc.

All or some of these factors are taken into consideration by the different administrations and the actual amount of work to be done in any year is determined primarily by inspection on the ground, eventually by track recordings.

On the Danish State Railways, a chart has been made for each gang, fixing the average number of workdays per year thought necessary to carry out this work, which is the same from year to year, (Work required for maintenance under normal conditions.)

The chart consists of 3 parts :

1) there has been fixed a coefficient for each gang expressing the number of men required for maintenance of 1 km track (main track as well as service track) considering the character of the line (track construction and type of ballast as well as other technical conditions) and the traffic on it, and moreover based on the knowledge of the work of the individual gang accumulated during the years.

These coefficients vary from gang to gang from 0.8 to 0.3 during summer period (1/3-31/10) and from 0.6 to 0.15 during winter period (1/11-28/2);

2) maintenance of private tracks varies much from place to place.

The number of workdays on an average which experience shows to be necessary to

maintenance of each single private track has been stated.

3) the number of workdays on an average which experience shows to be necessary for carrying out other works which are the same from year to year.

B. — Cycle of operations.

1. *Maintenance work can be broken down into :*

   a) *work done according to predetermined cycles;*

   b) *work done after systematic surveys;*

   c) *work done gradually, when necessary.*

2. *What operations would you group under each of these 3 headings?*

It depends much upon local organization whether maintenance work is done according to *a*), *b*) or *c*).

Generally under « work done according to predetermined cycles » fall works as for instance : general overhaul, track surfacing, tightening fastenings and joints, weed killing and grass cutting.

When using mobile gangs general overhaul and track surfacing are very often done according to predetermined cycles, the length of the cycles depending upon the character and amount of traffic, and the degree of permanence with which the work is done. Definitely, these cycles have become longer in recent years, due to the improved quality of materials used in the track structure, improved drainage, methods of stabilizing the roadbed, and the extensive use of power tools and machines which do better work.

Whereas out-of-face track surfacing was common on many American Railroads on a three-year cycle, today many of these railroads have increased this cycle to five years.

Tightening must be done at predetermined short cycles.

Weed killing and grass cutting take place during the same season each year.

Generally under « work done after systematic surveys » fall works as for instance : renewal of rails, sleepers, fishplates, etc., regrading and lifting, ballast cleaning, adjusting points, adjustment of gauge, etc.

Generally under « work done gradually, when necessary » fall works as for instance : strengthening of formations, cuttings and embankments drainage, spot surfacing, spot re-sleepering, adjusting expansions, rail turning, replacing and repairing (welding) defective track parts, spike driving.

On the British Railways, work is done according to the systematic maintenance table given on the following page.

3. *What is the relative importance of each of these operations on the different categories of lines?*

No answers received covering the question.

4. *In the case of operations carried out according to a cycle, does this depend upon the classification of the line?*

The cycle is usually fixed by local experience and depends upon the importance of traffic as well as type and age of track-construction.

5. *In the case of operations carried out after a survey, is this done directly or by taking recordings?*

In many Railway Administrations the operations : levelling, realignment and regauging are carried out as a result of visual inspections on the ground by the supervisory officers of the maintenance of way organization, beginning with the gang foreman.

In some countries, these inspections are supplemented by recording devices operated over the tracks or the decision to make a visual inspection results from a study

SYSTEMATIC MAINTENANCE TABLE

FORM No.

This Table must be followed, except when the Ganger considers it necessary to depart from it in order to carry out prompt repairs to the track (Inspector to be notefied) or where alternative work is authorised by the Inspector.

Week No.	*Week containing*	*Work to be carried out Monday, Tuesday, Wednesday, Thursday, Friday*	*Saturday a.m.*
1	Jan. 1st	Tidy week	Overhaul P. & C. fastenings. Repair and clean up sidings.
2 3	Jan. 8th » 15th	Overhaul chair fastenings and re-gauge Burn dead grass when weather suitable during weeks 3 to 13 inclusive.	
4 5 6	Jan. 22nd » 29th Feb. 5th	Repair and align track	
7 8	Feb. 12th » 19th	Turn and oil fishplates, examine rail ends, pull back rails.	
9	Feb. 26th	Recovery week	
10 11 12	Mar. 5th » 12th » 19th	Turn and oil fishplates, examine rail ends, pull back rails	
13	Mar. 26th	Overhaul chair fastenings and re-gauge	
14	Apl. 4th	Tidy week	
15 16 17 18 19 20	Apl. 9th » 16th » 23rd » 30th May 7th » 14th	Repair and align track	
21 22 23 24	May 21st » 28th June 4th » 11th	Weed and clean cesses, trim verges, hoe fire breaks, cut and burn slopes	
25 26	June 18th » 25th	Clean out drains	
27	July 2nd	Tidy week	
28 29 30 31	July 9th » 16th » 23rd » 30th	Repair and align track	

Week No.	*Week containing*	*Work to be carried out Monday, Tuesday, Wednesday, Thursday, Friday*	*Saturday a.m.*
32 33 34	Aug. 6th " 13th " 20th	General repairs, carry out fencing on hand, tarring huts, etc.	Overhaul P. & C. fastenings. Repair and clean up sidings.
35 36	Aug. 27th Sept. 3rd	Overhaul chair fastenings, re-key where necessary, re-gauge	
37 38 39	Sept. 10th " 17th " 24th	Repair and align track	
40	Oct. 1st	Tidy week	
41 42 43	Oct. 8th " 15th " 22nd	Hedges, ditches, fencing, clean out and repair drains	
44	Oct. 29th	Recovery week	
45	Nov. 5th	Overhaul chair fastenings and re-gauge	
46 47	Nov. 12th " 19th	Pull back rails	
48 49 50	Nov. 26th Dec. 3rd " 10th	Repair and align track	
51 52	Dec. 17th " 24th	General repairs	

GENERAL NOTES

1) *Repairing track* : During these periods any bad places must first be dealt with. During remainder of allotted time packing, lining, and adjustment of cant should be carried out systematically commencing at one end of the length and continuing each new period from the point which was reached at the end of the previous period.

2) Ballast riddling, packing and aligning of track is not to be done in very hot weather.

3) Cleaning of ballast is not specified in the above Table, but the gang's allotted task is to clean a minimum of 15 lin. yds. (*) of track per man per month. This work is to be carried out progressively from one end of the length to the other. If this is omitted in any given month it must be made up in succeeding months. (*) (12.72 mètres).

4) Although repairs to fencing and drainage work (which include cleaning of catchpits) is shown to be done only at specified periods, it must be understood that this work is to be dealt with any other time as it becomes necessary.

5) Small road repairs are to be dealt with as soon as possible after they become necessary.

This Table should be issued to all gangs, except those entirely employed in tunnels, or where other special circumstances obtain.

of records relating to the length of track in question.

Only a few of the railways concerned use the recording devices as base for the maintenance work in question.

6. *In the case of direct surveys, does this embrace the whole line or is it only made at various points?*

These surveys may embrace entire railways, although it is a fact that special surveys may be made at points presenting particular problems. Some railways carry out the survey at certain points only as a result of reported troubles.

7. *Are recordings made by light machines running over the lines or by special vehicles?*

8. *In the latter case, do you record the position of the rails or the reactions of the vehicle?*

The most commonly used recording machine has been the Hallade recorder-portable or mounted in a special car — which records the reactions of the vehicles. It is important always to use the same car to be able to compare the recordings.

In Europe and in one case in the U. S., special cars are used with recording equipment recording the position of the rails.

By the Mauzin track inspection car the records are made in the vertical plane:

1) of the relative levels of the rails;

2) of irregularities in each line of rail;

3) of variations in the cant of the rails;

and in the horizontal plane:

1) of the accuracy of the gauge;

2) of the degree of curvature on each rail.

The Danish State Railways mention besides the Mauzin-car the use time and again on special occasions of Dorpmüller machines (light machines pushed by a man over the tracks) recording the relative levels of the rails and the track gauge on unloaded track.

C. — Determination of the details of the work to be carried out.

1. *What managerial grade decides the details of work to be done?*

2. *Are direct surveys or recordings used?*

3. *From your experience what operations are most suitable for each of these methods?*

Recordings alone can only be used when the position of the rails is recorded, for instance by the Mauzin-car. These recordings only regard levelling, line and gauge. Wear, re-tightening, rotten sleepers and the like must be examined on the spot.

Other machine recordings than the Mauzin-type are normally supplemented by direct surveys.

* * *

The introduction and regular use of recording-car of the Mauzin-type once or several times a year have exercised a revolutionary influence on the planning of the maintenance of way work and on its effectiveness.

The central maintenance officer, without being dependent of the information received from the local personnel — which information might be somewhat coloured by personal interest of the staff — can ascertain the development of the track standard directly from the recordings. (Progress or deterioration, places where work should be done, etc.)

For instance, it becomes possible to do away with eventual rather rigid predetermined cycles of track surfacing, and instead, based on the knowledge of the recordings year by year to fix which lines are really the most in need of surfacing and thus to exploit the available capital in the best possible way.

Local maintenance officers have in the recordings a detailed view of the tracks and of the work of the gangs, a view which it has earlier been impossible for them to get because of lack of time for such minute investigations in the field.

From the recordings, it is possible for the gang foreman to see exactly for instance which single point of the track is in need of special maintenance.

It is also of great instructive importance that you can discuss the details of the development of the track with the gang foreman thereby also discussing the results of his own work.

As thus, based on the recordings both by the planning of greater works and by the execution of local works, work can be done just where it will have the greatest effect, the use of detecting recording coaches — recording the position of the rails — has an extraordinary great economical importance.

D. — Control of the way the work is done.

1. *When the work is completed, do you make a systematic check of the quality of the work?*
2. *Is this check made by direct continuous survey or by surveys at given points, or is it done by using a recording vehicle?*

On most railways, the local supervisory personnel normally controls the work as it progresses by direct continuous surveys sometimes followed immediately by Hallade or Dorpmüller recording machines or eventually after sometime by a recording vehicle of the Mauzin-car type.

III. — ORGANISATION OF THE WORK. AMOUNT OF MECHANIZATION.

A. — General considerations.

1. *Do you carry out all the maintenance operations simultaneously over a given length of track, or do you divide it up into elementary phases which are carried out in turn?*

Most Administrations divide the maintenance operations into elementary phases. In special cases, two or several phases are carried out simultaneously.

Only in case of general overhaul operations are simultaneous.

As the concentration of men makes supervision easier, it would be an advantage to carry out as many maintenance operations as possible simultaneously over a given length of track.

2. *What do these phases consist of (levelling, shimming, lining, overhauling the material, for example)?*

The elementary phases can for instance consist of : levelling, lining, overhauling of track material, replacing of defective material, tightening of fastenings, spike driving, etc.

3. *Do you divide the operations involved in overhauling the material into several phases?*
4. *In what order are these operations carried out, and what reasons led you to adopt this particular order?*

No general rules exist. The order of the operations — separately or in conjunction with each other — can depend on the most suitable season, local conditions, availability of material, the interest of the greatest efficiency and economy, the effort to minimise the interference with train operations due to the necessity for speed restrictions.

5. *Do you impose speed restrictions when certain operations are being carried out?*

Most railways use speed restrictions — often as low as 30 km (19 miles) (rail laying, bridge repair, etc.).

One of the serious obstacles to sustained high-speed train operation are speed restrictions imposed by track maintenance forces and consequently the maintenance department must try to avoid speed restrictions in connection with track maintenance work wherever possible. But unless speed restrictions are used in connection with many different track maintenance works

substantial increases in the cost of the work are experienced and the work cannot be done efficiently, consistent with safety and with a proper regard for the quality of the work itself.

There are many maintenance operations which cannot be done unless the maintenance forces have the benefit of a speed restriction, except in those circumstances, when it is possible to detour traffic.

It is not possible to give a figure of general application for the percentage of productive man-hours saved by the use of speed restrictions since this depends on many varying factors, such as the size of the maintenance of way force, the frequency and spacing of trains, the type of operation under way and local conditions, but in the following is given an example :

in light track raising or general surfacing operations where the raise is in the order of 5 cm (2″) or less it is possible to increase the production of the gang substantially and improve the quality of the finished work if a speed restriction is used. When used, it is not necessary to make frequent long run-offs for the passing of trains, which will result in more uniform final surface, and based on American reports, it will also result in savings of productive time of not less than 15 min per train, and substantially more under some circumstances.

In the case of rail laying, there are many justifiable reasons for the use of a speed restriction which are paramount to sustained high speed operation of trains. These include loss of productive time, which — in the U. S. — is estimated to be not less than 25 min per train for the entire maintenance of way force, in addition to the time required if a speed restriction is used, the damage which is likely to occur to the rail if operated over at high speed before the necessary smoothing is done, the safety of train operation, and the safety of maintenance forces. For these reasons it is the general practice to lay rail with the benefit of a speed restriction.

The same factors of safety and economy are applicable in the case of ballasting, especially when the work involves complete cleaning of the cribs.

To minimize the effect of speed restrictions, it is the practice on American railroads and on some European railways to schedule maintenance operations which will require the use of speed restrictions in such a manner that there will be only one maintenance speed restriction at a time on an operating district where practicable.

Some American railroads exempt certain high-speed passenger trains from the speed restrictions. Maintenance of way forces, informed of this fact, are required to have the track in readiness for the passage of these particular trains.

It would be of great value — as well for the maintenance forces as for the operating department — to construct new signalling installations on double track lines in such a way that the signalling personnel — with a short warning — have the possibility to arrange normal single track operation (without speed restriction on account of the single track working) thus permitting the maintenance of way works to take place on a track without traffic and consequently to be made faster (less expensive) and more efficient. One railway reports the doubling of the production on a certain maintenance work when the track in question could be without traffic during working hours.

B. — Influence of the traffic on mechanization.

1. *In the case of sections where mechanization is now highly developed, how many trains run during the time the work is being carried out?*

   a) *on the track concerned?*

   b) *on the adjoining track or tracks in the case of multitrack lines?*

2. *What is the practical duration of the long intervals which the gangs provided with mechanical equipment can count on?*

3. *What is the average interval below which they cannot commence working?*

Few Administrations have answered these questions categorically.

It depends upon the number of trains listed in the timetable and other trains operated in addition thereto and in consequence varies much from line to line.

The average interval below which the on-track equipment cannot commence working is about 1/2 hour.

On railways with heavy traffic on single track lines on-track machines are not economical because of the time which would be lost with passing trains.

4. *Is the track protected during work:*

   a) *by mobile signals?*

   b) *from the stations?*

In most cases by mobile signals.

By the stations when large on-track equipment is used or when track is out of use during work for instance on account of rail renewal.

5. *What warning do you give to make sure the gang and equipment are clear of the line in time?*

Warning is normally given by look-out men equipped with whistle or horns, one or more being provided dependent upon the type of work, the distance over which men and machines are working, or the particular local conditions (curves where visibility is restricted).

Temporary telephones to the rear, are sometimes provided, particularly when using on-track machines, to enable warning to be given and for the purpose of informing the signalman when the machine has been removed from, or placed on, the track.

When the track is protected from stations, telephone message is given to station by gang foreman.

6. *How much time is lost every time a train passes in getting clear and bringing back the mechanical equipment?*

It much depends upon the type of equipment used, varying from 5 to 40 min when using for instance power hand tamping or on-track tamping machines.

7. *Is mechanization particularly extensive in the case of work in connection with:*

   a) *levelling, shimming and lining up;*

   b) *consolidating the material;*

   c) *replacing the material;*

   d) *cleaning the ballast (including weeding);*

   e) *maintenance of the surrounds (ditches, embankments, etc.)?*

While mechanization is extensive in the U. S. in connection with all works mentioned, in other countries — where mechanization has just started — use is particularly made of both on-track and off-track tamping machines and weed killing trains as well as many types of small power driven tools (rail drills and saws, nut and coach screw runners, spike drivers, grass cutting machines, etc.).

C. — Kind of equipment.

1. *Can you give a list of the tools or motors used by your gangs, stating:*

   a) *whether these are self-contained tools or motors, or groups of tools working off a motor generating set;*

   b) *the power and average weight of these tools or motors;*

   c) *the method of moving these motors or tools (rails or paths).*

2. *Which are the ones you are most likely to develop?*

Various types of power tools and machines are used for nearly every kind of maintenance work. Most of these tools

and machines are described in the reports for the Enlarged Meeting of the Permanent Commission, Lisbon 1949.

Some of the power tools, such as on-track tamping equipment, are self-contained tools, while others, for instance off-track tamping equipment, are tools operated in groups working from a motor-generating set or air compressor.

The hand tools may weigh up to 35 kg each, whereas the motor-generator outfits or compressors may weigh up to several tons.

Some of this equipment has flanged wheels and is moved on the track rails, while other of the equipment is off-track mounted on rubber-tyred wheels, or on Caterpillar tracks. A small amount of the smaller power units is not mobile and is moved from place to place by the gangers.

The preference for on-track equipment or off-track equipment depends upon many considerations, including the character and extent of the traffic on the lines involved, the width of cuts and fills, and the production possible with the different types of machines. While there has been extensive development in off-track machines for use to the fullest extent possible in the U. S., the most recent trend on American Railroads has been toward certain on-track machines, such as large production ballast cleaners, multiple tamping machines, etc.

D. — Use of mechanical tools.

1. *Is the present organization of your mechanized gangs the result of successive trials?*

2. *Can you give any diagrams showing the functioning of gangs using mechanical tools or motors?*

3. *Has the introduction of mechanization obliged you to modify your ideas about the grouping of maintenance operations and the order in which they are carried out?*

Apart from the railways in the U. S. the mechanized maintenance gangs are as yet only on an experimental stage in most of the countries concerned.

When mechanization is started or further extended on a railway, time studies must be used to standardize practices of gang organization and machine assignment.

Machine failures in the field can be extremely costly in loss of production and wasted man-hours, everything must be done to avoid such failures.

It is essential that a definite programme must be followed for the periodical inspection, adjustment and minor repair of all mechanical maintenance equipment.

This conviction has led some railways to establish an organization designed to give its work equipment the attention it needs.

Such an organization comprises two elements, namely:

1) well equipped and trained field repairmen, who make frequent inspections of equipment in the field and light repairs. To permit such a repairman to get around as quickly as possible and to carry with him all kinds of tools and spare parts, he must have at his disposal a specially equipped highway motor car;

2) a modern centrally located repair shop for heavy repairs to the mechanical maintenance equipment and for periodical overhaul of the equipment at least once a year. It is of importance for the planning of the work of the mechanized gangs that such shops are under control of the maintenance of way department.

Two diagrams showing the functioning of a gang using a Matisa tamping machine and a sleeper renewal machine on the Swedish State Railways are shown on the following page.

E. — Results of mechanization from the technical point of view.

1. *Is mechanization of value in every case?*

2. *Should it be limited to certain types and certain conditions of the track?*

The mechanization is not limited to any type or condition of track but can be applied in varying degrees depending upon the results desired.

The results obtained give entire satisfaction as generally more uniform work can be obtained by the use of power tools than by hand labour. A uniformly maintained track keeps its standard for a long time, thus producing long-term economies.

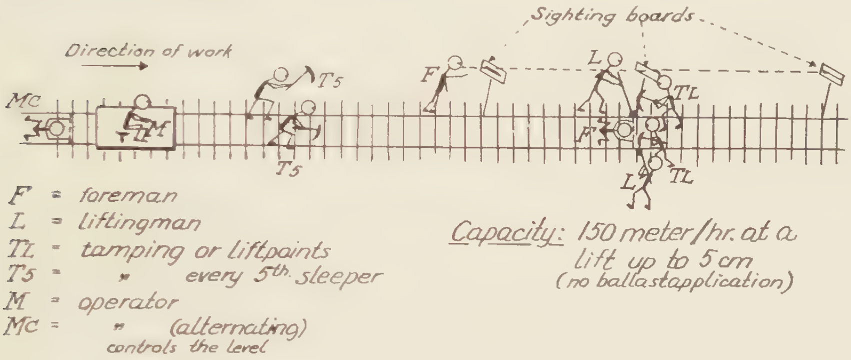
In the U. S. the practice is to mechanize operations in every instance where it has been found economical to do so, instead of using hand labour. This applies to section gangs as well as to larger extra and district gangs — the principal reason being the increasing cost of labour on American railroads.

The bases of several railways' maintenance organization is the small length gang which is directly responsible for a given length of track and from its very nature cannot be highly mechanized.

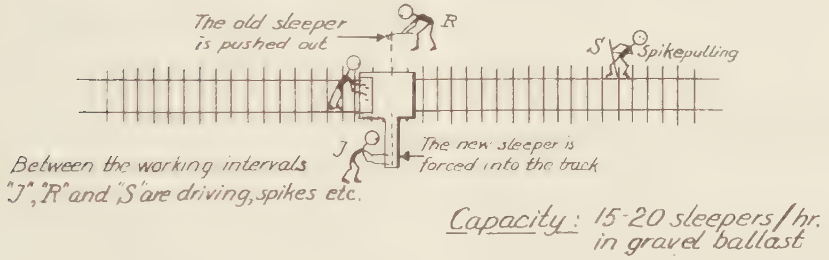
The greater proportion of all mechanical plant used by these railways for maintenance purposes is concentrated in central depots from where it is lent to the local gangs as required.

Levelling with Matisa tamping machine.

Size of gang : 2 foremen + 6 workers + 2 operators



Sleeper-renewal with a machine for removing and inserting sleepers



In some countries the gangs are not mechanised chiefly because labour is cheap and ignorant. The maintenance of machinery would here be a major problem.

IV. — IMPORTANCE OF PATHS FOR THE MOVEMENT OF THE MEN AND MACHINES.

A. — Nature and position of the paths.

1. *Is it your standard practice to have paths alongside the ballast?*
2. *Characteristics of these paths:*
   a) *width;*
   b) *level of the path relatively to that of the rails;*
   c) *distance of the path relatively to the rails;*
   d) *are they outside the supporting pylons in the case of electrified lines?*
   e) *is there a path on both sides in the case of double track lines?*
   f) *influence of the path on the conservation of the ballast?*

Most of the railways concerned do not provide paths as such, alongside the ballast, but the roadbed shoulder — established to maintain the ballast and thus avoid lateral weaknesses in the track — is used instead.

In the U. S. with the advent of a large amount of off-track work equipment for carrying out maintenance work, there has been a tendency on the part of many railroads to widen the track shoulder on fills, and to widen cuts, to permit the operation of this equipment alongside the track. These shoulders, of course, exist on both sides of the track in single-track territory, and along the outer sides of tracks in multiple-track territory. The level of the shoulders with respect to that of the rails depends upon the depth of the ballast section in the area in question. Where widened shoulders cannot be provided at railway bridges or at overhead railway or highway bridges, the equipment which is normally moved along the track shoulders must be run up onto the track structure and moved directly along the track through the restricted area.

Where this is not possible, the equipment is run around the obstruction by some other means and put in service on the opposite side of the obstruction.

It is the practice on the British Railways to provide a clear space « cess », rather than a path alongside the ballast wherever possible, so that men can safely stand clear of the traffic. The surface of this space is dependent on the material composing the original formation and may or may not be made up with ashes, quarry waste material or old ballast, consolidated or otherwise.

A path is provided alongside lines where shunting takes place.

Accordingly no standard dimensions are laid down, the width is 0.6-1.25 m (1′ 11 5/8″ to 4′ 1 1/4″) depth 0.5-0.8 m (1′ 7 11/16″ to 2′ 7 1/2″) in different countries.

It is essential that the path should be maintained at the proper relationship with level of the rails, so as to maintain the shoulder ballast and thus avoid lateral weaknesses in the track.

In the Sudan no paths are necessary since the country is quite open.

3. *When work is in hand is it possible to move about apart from the paths alongside the ballast?*
4. *If so, what width is available?*

Railways in other than European countries often have wide rights-of-way of 30 m (98′ 5 1/8″) or more on each side of the track.

5. *How are the paths taken past structures?*
6. *Do you allow the path to be interrupted at structures?*
7. *If so, after what span of bridge?*

On a few railways, structures are built

to provide clearance for the path to be continued through the area of obstruction.

One railway provide footwalks on bridges over 10 m (32′ 9 3/4″) span.

B. — **Machines running on the paths.**

1. *What are the maximum dimensions of the machines which can be taken along these paths?*
2. *What is their axle load and their load per centimetre of width of tread?*

American railroads operate a wide variety of equipment on the track shoulder, including cranes, draglines, ballast cleaning equipment, generator sets, air compressors, etc., which may range in width up to as much as 3 m (9′ 10 1/8″).

In other countries, it is very rare that any machines, other than small grass cutters, hoes and small compressors generators, are moved along the shoulders and the load imposed is negligible.

C. — **Advantages obtained by providing such paths.**

1. *Has the extended provision of paths made it possible for you to reduce the time lost by the men in getting to work or getting out of the way during work?*
2. *Do the advantages obtained by having paths as regards the movement of the men and machines justify their construction and upkeep alongside every line, or should they be limited to lines where the annual number of working hours per kilometre exceeds a certain figure?*
3. *Has the advantages of using large machines which can be taken along these paths led you to install a special system of paths for this purpose?*
4. *Have you any criteria enabling you to link up the cost of making and maintaining the paths with the number of working hours needed per kilometre run or tonnage carried by the line?*

The provision of paths adds greatly to the effective use of off-track machines, and provides more room for the men when they must clear the track for the passage of trains.

In some special cases the paths do reduce the time lost by men getting to work or moving in and out of the track during maintenance operations. Apart from this, it is of great importance for the safety to have paths sufficiently wide to permit the circulation on bicycles, thus making the use of track-bicycles, very extended in some countries, unnecessary and even reducing the use of motor-trolleys.

No reports of the cost of construction and maintenance of the paths have been received.

V. — ECONOMIC AND FINANCIAL ASPECT.

A. — **Evolution of the amount of labour devoted to maintenance.**

1. *With the present organization of your railway, what is the annual number of hours per kilometre of track devoted to the work given in the table below?*

Only a few railways in Europe have been able to answer this question more or less in detail:

Training of staff .	0-7	hours per km track
Supervision . . .	120-200	hours per km track
Maintenance of track	500-1150	hours per km track
Protection of staff	35-125	hours per km track
Weeding, cleaning ditches, repairing tools	25-375	hours per km track
Landslides, snow .	10-120	hours per km track
Maintenance of buildings and roads	125	hours per km track
Illness	20-70	hours per km track

2. *Is this number of hours sufficient to assure satisfactory maintenance?*

The number of man-hours of track maintenance used by the different railways has in general enabled them to maintain the track in satisfactory conditions, and in

some cases the track maintenance standard is steadily progressing.

But one Administration reports that an increase in man-hours of about 25 % ought to take place.

3. *Have you any statistics showing the evolution of the number of hours per kilometre of line by the permanent way gangs during the last 25 years, for all the operations for which these gangs are responsible?*

The number of man-hours used in maintenance of way and structures work on the American railroads as a whole has been reduced approximately 54 % over the past 22 years.

A reduction in man power of about 28 % has been made in the last 28 years on Coras Iompair Eireann.

In 1922, the Danish State Railways employed on a average theoretically 0.59 man per kilometre track, in 1952 the corresponding figure was 0.47, a reduction of 20 %. During the same time traffic (number of car-axle-kilometre per kilometre) has risen 65 %. Maximum speed on the main lines has been raised from 90 to 120 km/h (56 to 74 m.p.h.).

Moreover, track construction has been improved. The use of stone ballast on the main tracks has thus risen from 29 % to 72 %.

The use of heavy rails in main tracks has risen from 25.3 % (41 and 45 kg per metre = 82 and 90 lbs. per yard) to 53.2 % (41, 45 and 60 kg per metre = 82, 90 and 120 lbs. per yard).

This proves that it has been possible, in spite of heavier and faster traffic to reduce the necessary number of hours per kilometre of track by the maintenance of way gangs, without diminishing the maintenance standard of the track.

That this has been possible is due to:

1) improved track equipment, such as for instance: heavier rails, longer rails, harder or special steel in rails, modern fastenings and joint construction, modern switch, frog and crossing construction, closer spacing of sleepers, impregnation of sleepers, stone ballast;

2) improved maintenance, such as for instance: mechanization (produces uniform work in a short time and enables the gangs to repair practically every kind of damage on the track), modern levelling (measured shovel packing), welding, grinding, etc.;

3) improved organization, for the use of mobile as well as longer gangs which permits the men to be more specialised and thus to be able to produce more work.

4. *Fill in the table, if possible:*
   a) *cost of track materials;*
   b) *wages of railway staff;*
   c) *contractors;*
   d) *Total costs* (a + b + c);
   e) *total cost in comparison with the size of the system:*

$$\frac{d}{\textit{length of the system as obtained from table A. 2.}}$$

From the 7 answers received it appears that the total average real expenditure p.a. on the permanent way varies from U. S. $ 415 to 3 270 per kilometre on these railways.

By the railway involved, it is reported that the expenditure of $ 415 ought to be $ 1 000 to assure suitable track standard.

The expenditure of $ 3 270 is on a railway with very heavy traffic and rather difficult conditions for carrying out the maintenance work.

Normally $ 1 000-1 300 per kilometre is required annually.

The track work done by contractors is insignificant.

B. — Evolution of maintenance costs.

1. *Have you made any comparisons of costs covering a fairly long period, between gangs using hand labour and gangs using mechanized labour, the quality of the work being equal. In both cases, what proportion of the cost is attributable to:*
   a) *labour?*

b) *materials?*
c) *equipment (tools)?*
d) *consumable stores?*

2. *How much of the labour costs in each case are due to the cost of protecting the work?*

3. *How much of the labour costs are attributable to unproductive time:*
   a) *while the men wait for trains to pass?*
   b) *for moving equipment, etc.?*

On the Danish State Railways, the costs for gangs using Matisa tamping are about 40 % and the costs for gangs using Jackson tampers are about 65 % of the costs for gangs using hand tamping under the same local conditions. Not only do power tampers here produce direct savings in the cost of work but they result in more uniformly tamped track, which maintains its surface longer than track tamped by hand, thus also producing long-term economies.

The following table gives analyses of these costs:

		Matisa	*Jackson*	*Hand tamping*
1. *a*	cost attributable to labour	60 %	90 %	98 %
1. *c*	cost attributable to equipment	30 %	8 %	2 %
1. *d*	costs attributable to consumable stores	10 %	2 %	—
2.	labour costs due to protection work	0 % (*)	15 %	5 %
3.	labour costs due to unproductive time	20 %	15 %	15 %

(*) Protection by stations.

The costs of protecting track work vary widely, depending upon the number of tracks involved and the volume and speed of traffic. It would range from no added cost in the case of small section gangs where the foreman acts as watch-man, to heavy costs in the case of larger gangs operating noisy power equipment in high-speed territory, especially where heavy track curvature is involved.

The lost time of labour clearing for trains may vary all the way from 5 min up to 1/2 h or more depending on local conditions.

4. *How much do the transport costs amount to (time lost on the journey — driving the transport vehicles taking the men to the place of work in the case of large gangs — amortization and maintenance of the transport vehicles)?*

In some cases maintenance gangs can be working up to as much as one hour travel from their headquarters, but no specific report on the question has been received.

5. *How much additional cost is involved when a gang has to work away from its headquarters?*

6. *Is the normal wage raised because of this?*

This depends entirely upon the location of the work and the size of the gang and can involve overtime in pay, special allowances for work away from normal gang length or housing of the men.

7. *Have you any data to show the increase in the cost of maintenance per kilometre in terms of the age of the track?*

No data received, probably because it is often the practice to remove material from main lines before it is worn out and to

re-use it on secondary lines, and subsequently in sidings so that the track is not subject to the same degree of wear throughout its life.

VI. — CONCLUSION.

Have methodical organization of the work and in particular mechanization enabled you to improve the quality of the work and reduce maintenance costs to such an extent that the time between two systematic renewals can be appreciably extended ?

No detailed records on the question have been received but several railways declare that methodical organization of the maintenance work as well as mechanization reduce maintenance costs and lengthen the life of the material.

Summaries.

Until recently the permanent way gangs have generally been organized as short length gangs responsible for the entire maintenance work of the track length in question (supervision, maintenance work proper — as for instance levelling, lining, gauging, weed killing — and various other works of local character).

Especially in countries where increasing wages have made it necessary to get the very most out of the working power, trials have successfully been started with longer gang lengths or with mobile gangs in connection with reduced local gangs.

The introduction of such gangs permits :

1) the reduction of the number of gangers as well as of supervision personnel;

2) the extension of mechanization;

3) the specialisation of the gangers;

4) the production of more uniform and consequently more durable work;

5) the greater ability for the gang to carry out major item of track work.

* * *

The determination of the maintenance works to be done has for many years generally been based on :

1) the experience of the durability of the work under the local conditions involved (predetermined cycles). This depends partially on an estimate and can vary much from place to place;

2) the very careful examination in the field of the track (systematic surveys). These surveys are complicated and take much time;

3) the appearance of trouble in the track. When this takes place defects may be so developed that they are irreparable.

The drawbacks of these methods have now in many countries been essentially reduced or quite abolished by the use of detecting-recording devices.

The Hallade type machines (recordings of the reactions of the vehicles) give — when always used in the same car moved with the same speed — a remarkable base for comparison between the track-standard of the different lines and a general view of the individual track.

The Mauzin-type recording vehicles (recordings of the positions of the rails) give directly an exact recording of the position of each individual rail of the track in the vertical and horizontal plane, and of their mutual distance.

Where such vehicles are used regularly practically all decisions on levelling, lining and regauging as well as checks of quality of work can be made on the base of the recordings — without possibility for mistakes.

The use of recording vehicles — especially of the Mauzin type — is of extraordinarily economical value, because it permits the maintenance work to be done exactly on the right spot and just at the correct moment, with consideration to the track-standard of the entire railway system.

* * *

As well for economic as for technical reasons it is of the greatest importance that planning of maintenance works is done under close collaboration between maintenance and operating officers to establish appropriate speed restrictions or detouring of traffic to other lines or tracks, with due consideration to the traffic and to the type of work involved.

* * *

The mechanization of the maintenance of the permanent way has been discussed at the 1949 Enlarged Meeting of the Permanent Commission at Lisbon and has been still further extended.

The mechanization is especially advantageous for use in larger gangs and thus greatly co-operating to the satisfactory results of the above mentioned trials with such gangs.

To get the utmost out of the use of mechanical tools the following special organization for the running and maintenance of such tools is indispensable :

1) the same operators must constantly take care of the mechanical tools;

2) such operators must be well trained before starting work;

3) repair and general overhaul of the tools must be in the hands of field repairmen and central repair shops.

* * *

The final summaries adopted at the Enlarged Meeting of the Permanent Commission (Lisbon, June 1949) mention the paths for the movement of the men and machines as follows :

« It is desirable in future in the case of new railway construction or when modifying existing lines to provide large cesses to facilitate the use of mechanical equipment and generating plant. »

Besides this, the existence of such paths are also very desirable for the safety of the men, because in a large measure they reduce the movement of men to and from the working place on the track.

[656 .257]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th. SESSION (LONDON, 1954).

QUESTION 6.

A) Remote operation of signal boxes : technical realizations, working orders.

B) Electric working and control devices for hinged and « flexible » points and switches. Control of accidental trailing of the switch blade.

REPORT

(America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible),

by R. Sørvik, MNIF.

Chief signal engineer, Norwegian State Railways.

Thirty-seven Administrations were consulted and replies were received from twenty-four.

The following Administrations gave detailed information on the questionnaire concerning either section A and B or section B only :

Association of American Railroads (A and B);

British Railways (B);

Ceylon Government Railway (B);

Danish State Railways (B);

Finnish State Railways (B);

The New Zealand Government Railways (A and B);

Norwegian State Railways (B);

Rhodesia Railways (A and B);

Swedish State Railways (B);

The Railway Board, India (B).

PREFACE.

The answers of the different Administrations have been summarized and as far as possible given a general form, however, when the answers from the different Administrations differ, they are mentioned separately. Sometimes the answers have been commented on or information are added according to the personal view of the writer. Some of the answers may just be « Yes » or « No » when the Administrations have had no special comment.

Since remote control and C.T.C. have been developed and used on a far larger scale by U.S.A. than by any other country, the replies of the Association of American Railroads (A.A.R.) should be of special interest even though the basic methods and practices employed on American railroads

are different from those of many other Member Administrations of the I.R.C.A. (International Railway Congress Association). The replies of the A.A.R. are therefore in the following referred to rather frequently inasmuch as these replies are of a common form representing the usual practice and experience of all the railroads in U.S.A.

As to the questionnaire, this was originally worked out in French and afterwards translated into English. The translation was somewhat inaccurate and a partly revised edition was distributed.

However, the writer has taken the liberty in this report further to change the following expressions, which were used in the distributed questionnaires :

« Operation orders » are changed to « controls » and « controls » are changed to « indications » according to American and as far could be seen also to British signal terminology.

The word « telecontrol » is unchanged and used as a joint expression for « remote control » and « C.T.C. ».

Some of the questions have not been answered by the Administrations or have been answered, misunderstanding the meaning of the questionnaire, either owing to unnormal terminology in the questionnaire or sometimes because the questions are so special that information might perhaps be better had from the publications of the signal companies.

A. — REMOTE OPERATING OF SIGNAL BOXES, TECHNICAL REALIZATIONS, WORKING ORDERS.

Question 1. — *What reason have led you to install telecontrol equipment :*

a) *an increase in the traffic rhythm ?*

b) *labour economies ?*

c) *to avoid extending the track installations ?*

d) *other reasons ?*

Ans. 1a), b) and c). — Yes.

Ans. 1d). — U.S.A. (A.A.R.) have given following reasons for installing C.T.C. :

1) to permit abandonment of trackage by increasing traffic capacity of remaining main track or tracks;

2) code control in most instances costs less than direct control;

3) to provide needed capacity at locations where adverse physical conditions restrict number of tracks.

The A.A.R., Signal Section 1950 has further summarized the following economic advantages of C.T.C. :

4) elimination of train orders and the possibility of errors in issuing, transmitting, interpreting and executing train orders;

5) better supervision of train operation is obtained by the dispatcher, as changing traffic conditions are immediately reflected on his operating board. This enables the dispatcher to change the line-up of train operation with increased facility and safety;

6) train delays are also reduced, as experience shows that many meets on single track are so well timed that neither train stops;

7) capacity of the line is increased by the use of power switches and the more frequent and accurate OSing of passage of trains through the 24 h, which makes it possible for the dispatcher to change his scheme of operation as traffic conditions permit;

8) increased safety is obtained where power-operated switches are used because :

a) reduction in number of stops results in less wear and damage to equipment and, consequently, there is less chance of accidents and personal injury;

b) power switches may be used to route trains around obstructed track and may serve to give derail protection to train standing on the main track awaiting a meet;

c) eliminates chances of personal injury to trainmen running ahead of train to open

switch, in operating switch, or running to catch train after closing switch;

d) trains are kept in motion a greater portion of the time, and the chances of collisions are reduced;

9) instructions governing the movement of trains are given by signal indications displayed at the point where action is required, by the control operator to the engineman, eliminating intermediary action by other employees. This concentration of control of train movements eliminates individual judgment which cannot always coordinate to the best advantage in the most expeditious and safe movement of trains;

10) it provides additional protection for a train working between switches at end of sidings, as often other trains can be run around the working train. This form of operation may, in many cases, permit the elimination of yard limits;

11) it provides controlled signals at many points which may be used by the control operator to stop trains when employees report dragging or defective equipment or other unsafe conditions;

12) its operation shortens the running time over the territory and, consequently, reduces the number of meets per trip, thereby reducing the possibility of accidents;

13) it has brought about a higher standard of maintenance of switches and sidings, increasing safety of operation;

14) additional protection can be given for the movement of track cars and other maintenance-of-way department equipment, as the control operator can protect these movements by signals;

15) because there is less standing time on sidings, the « freezing up » of trains in cold weather is less likely to occur;

16) it provides greater safety at times of peak business, as the control operator can more efficiently direct increased traffic;

17) it increases safety by eliminating the necessity of checking train register and identifying trains at meeting points;

18) it increases the over-all efficiency of operation by placing the entire control of trains under the dispatcher;

19) it obviates the immediate need for additional trackage, by increasing the capacity of existing track facilities;

20) it reduces the cost of operation by releasing switchmen and operators;

21) it increases availability of locomotives, cars and operating personnel.

Question 2a). — *Do you use telecontrol by preference on your single track or double track lines? Why?*

Ans. 2a). — Telecontrol is preferred on single track lines. As to double track lines A.A.R. states that double track lines require more traffic to justify economically.

Question 2b). — *Have you any telecontrol posts intended for the centralized operation of the points and signals of stations on single track lines?*

Give for each telecontrol post:

i) *the amount of traffic on each line in question.*

Ans. 2b), i. — Rhodesia Railways: One line with 12 trains each way per day.

The New Zealand Government Railways:

C.T.C. - Section 1 : 20 trains each way per day;

C.T.C. - Section 2 : 27 trains each way per day;

C.T.C. - Section 3 : 38 trains each way per day.

The given number of trains are scheduled and are minima.

U.S.A. (A.A.R.) : There has been given no information as to the total amount of traffic on all the telecontrolled lines.

January 1, 1952, 81 of the Administrations had installed C.T.C. and the total number of control machines including

machines for single, two or more tracks was 844.

The total number of trains per day governed by all these C.T.C. — machines may by guess of the writer amount to about 30 000. As an example of typical traffic on a single track line section may be mentioned : Las Vegas to Caliente, Nev. on the Union Pacific — 125.3 miles — 35 trains per day (1947).

An example of a very busy single track line is the 27 miles section between Roots and Raddle on the Missouri Pacific. This stretch of single track connects two sections of double track. As many as 84 trains, some of them more than 100 cars long, have traversed this section in a single day. The average is 70 trains daily (pamphlet 750, G.R.S.).

In addition to the C.T.C. operated areas comes the remote control of installations which are included in the term « telecontrolled posts ». 67 Administrations have installed remote control of a total of 709 electric and 107 electropneumatic interlockings (January 1952).

Question 2b), ii. — *The number of stations and local posts telecontrolled.*

Ans. 2b), ii. — Rhodesia Railways : 13 stations and sidings controlled.

The New Zealand Government Railways:

C.T.C. - Section 1 : 1 station 1 terminal;
C.T.C. - Section 2 : 1 station 1 terminal;
C.T.C. - Section 3 : 7 stations 1 terminal.

U.S.A. (A.A.R.) : No special comment given. Almost any number of stations may be telecontrolled from one machine, only limited by the amount of traffic and of the size of the machine allowing a suitable operation of the levers, push-buttons, etc.

Question 2b), iii. — *The number of points and crossings telecontrolled from the most important post and total number of points and crossings.*

Ans. 2b), iii. — Rhodesia Railways : 26 points and crossings (total).

The New Zealand Government Railways:

16 points telecontrolled;
20 points total.

U.S.A. (A.A.R.) : No special comment given. Ex. of many points in a small C.T.C. area :

Municipal Bridge, St. Luis (6.2 miles of road, 6.4 miles of track). One machine controls 30 points. The total number of points telecontrolled by 844 machines in C.T.C. areas are : 7 716 points controlled and 5 630 points electrically locked. In addition to the above mentioned points come those which are « remotely controlled » but the number of these are not available.

Question 2b), iv. — *The length of route telecontrolled.*

Ans. 2b), iv. — Rhodesia Railways : 110 miles.

The New Zealand Government Railways:

C.T.C. - Section 1 : 10 miles;
C.T.C. - Section 2 : 7 miles.
C.T.C. - Section 3 : 16 miles.

U.S.A. (A.A.R.) : No special comment given.

The length of route telecontrolled from one machine may be anything up to more than 100 miles.

Ex. 110 miles between Waynoka, Okla. and Canadian, Tex. on the Atchison, Topeka and Santa Fe. By installing more machines at a central point almost any length of route may be telecontrolled.

In U.S.A. (January 1952) the total length controlled by C.T.C. was 16 543 miles of road and 18 820 miles of track.

Question 2b), v. — *Length in kilometres between the posts telecontrolled and the Central Post.*

Ans. 2b), v. — The New Zealand Government Railways :

(section 3). 8 miles (12.8 km).

U.S.A. (A.A.R.) : No special comment given.

Normally when the control machine is placed at the end of or at a central place of the telecontrolled line the nearest C.T.C. section up to a certain length is controlled by conventional direct current (codes). The length is dependent of the number of stations and the physical condition of the transmission line. The next and following sections may be controlled by carrier currents superimposed on the same transmission line. The superimposed currents are converted at the beginning of each section into direct current (codes) as each section is appointed a certain carrier frequency.

There is a tendency to centralize the operation of C.T.C.-areas in headquarters to obtain a better and faster cooperation between the dispatchers controlling the different areas of the railway system. The distance from the C.T.C.-machine to the beginning of the controlled C.T.C.-territory may in this case be any length as it is normally used carrier current between the machine and the C.T.C.-territory.

Ex. In Amarillo on the Atchison, Topeka and Santa Fe one machine controls a C.T.C. territory beginning at Canadian Tex. 98 miles away. (Railway Signaling 1947.)

Question 2c). — Idem as 2*b*) *but relating to telecontrol on « double track » or « multiple track » lines, stating if this covers the general direction of running on all the tracks or only on some of them.*

Ans. 2c). — No double track telecontrolled neither by Rhodesia Railways nor The New Zealand Government Railways.

U.S.A. (A.A.R.) : No special comment given as to question 2*c*) i to 2*c*) v.

Ex. of double track installation :

The Delaware and Hudson Railroad installed 1936 C.T.C. on 6 miles of double track handling up to 339 trains and locomotives daily from one control machine (Pamphlet 750 G.R.S.). In the year 1952, 13 Administrations installed C.T.C. on 148 miles of double track. (Railway Signalling January 1953.) The total mileage of C.T.C. on double or more tracks in U.S.A. is not available.

The direction of runnings on the tracks is dependent on the traffic. If there is heavy traffic density both (or more) tracks are signalled for movements in both directions. If more moderate traffic exists one track is signalled for movements in both directions or both tracks are signalled for one direction only.

Information about remote control of interlockings on double or more tracks have not been made available.

Question 3a). — *Are there any stations with several by-pass lines which are telecontrolled? In such a case, is the station divided into several telecontrolled zones, or does it come under a single telecontrolled zone?*

In the first case, according to which of the enclosed diagrams do you link up the sections with the telecontrol system?

Ans. 3a). — There are many stations with several by-pass lines which are telecontrolled. The stations are generally divided into several telecontrolled zones and are linked up in accordance with case 1 (diagram 1).

Question 3b). — *Up to what importance (number of tracks — number of trains) is it rational to telecontrol stations, and after what size or what amount of traffic should such stations be permanently staffed by Operating Department Staff or else only staffed at peak periods?*

Ans. 3b). — Rhodesia Railways answer that if a large amount of shunting is undertaken at a station, local signal control slotted with C.T.C. is provided.

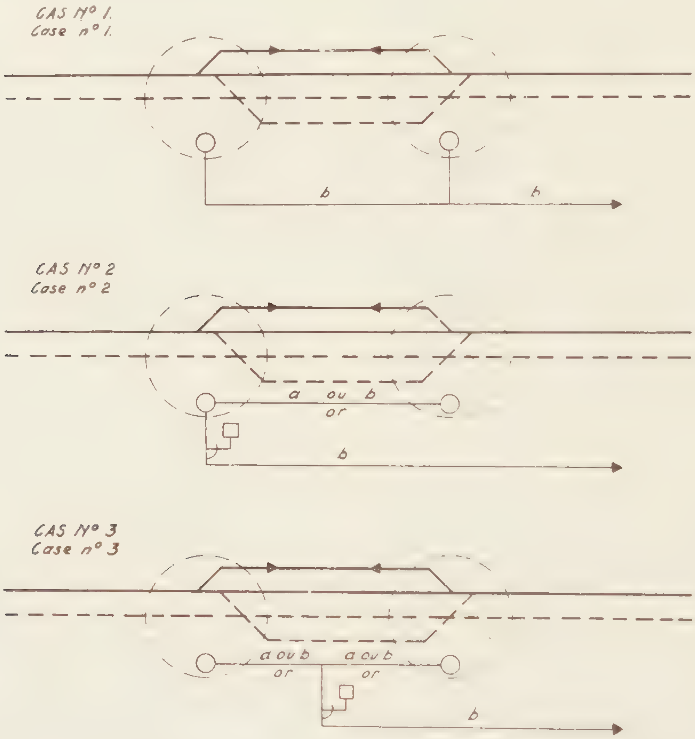
New Zealand C.T.C. stations are not staffed for train operation but staff are present for certain parts of the day for selling tickets and local station work.

U.S.A. (A.A.R.) : Signalling at any station regardless of the number of tracks and number of trains can be and is remotely controlled. No limits of telecontrol as to the amount of traffic. Only the amount and nature of business done determine the Operating Department Staff regardless of number of tracks and number of trains.

minimum and maximum distances from the Central Post.

Ans. 3c). — In U.S.A. (A.A.R.) there are telecontrolled installations in large stations. Special information are not given. Ex. : The Missouri Pacific has at Kansas City Mo. an installation with remote control of two groups about one mile away on either side of the tower.

STATION CONTROLLED BY CTC



○ = local control point; a = distinct lines;
□ = C.T.C. control point; b = transmission system of remote control.

Question 3c). — *Have you realized any telecontrol installation for a distant group of signals and points in large stations, or close by junctions, in order to place the control of all the safety installations in one hand. Give the number of apparatus telecontrolled and their*

Question 3d), i. — *How are the block sections situated between the different tele controlled stations operated? Are line clear or occupied announcements repeated from the various block sections up to the central post?*

Ans. 3d), i. — 1st question have not been answered.

2nd question : Yes.

Question 3d), ii. — *Are only the approach section announced?*

Ans. 3d), ii. — The answer of U.S.A. (A.A.R.) is « not generally », which should include that there are installations with block-sections not individually indicated at the central post.

Question 3d), iii. — *Is the open or closed position of the automatic block signals announced?*

Ans. 3d), iii. — Rhodesia Railways have no C.T.C. with automatic block signals.

The answer of U.S.A. (A.A.R.) is : « Of the absolute automatic block signal — yes. Of the intermediate permissive automatic block signal — no », which indicates that both positions of the first type of block signals are announced and none of the latter type are announced.

Question 3d), iv. — *Do the automatic block signals mean an absolute or permissive stop?*

Ans. 3d), iv. — Signals governing movements over switches are absolute. Intermediate signals between stations are permissive.

Question 3d), v. — *For what automatic block signals do you use telecontrol? Are these signals telecontrolled posts operated directly by the Central Post, or are the operation and control of these signals first of all transmitted to the nearest station post and thence to the Central Post?*

Ans. 3d), v. — Telecontrol is used for absolute signals and they are directly controlled.

Question 3e). — *Do you provide emergency signals for the station signals and block posts of an absolute or non-permissive character and how are these signals operated (by the train staff, the head of the Central Post)?*

Ans. 3e). — No emergency signals are provided.

Question 4. — Cancelled.

Question 5. — *What is the capacity of the telecontrol system adopted, as regards the number of Local Posts which can be controlled and the number of apparatus which in each Local Post can be operated and controlled from the Central Post? Does the fact that the Central Post is situated or not at the extremity of the route affect its capacity.*

Ans. 5. — Rhodesia Railways : The present capacity of the existing equipment is 15 stations.

The New Zealand Government Railways : The Westinghouse circuit code system with a capacity of 81 stations (approximately 25 sidings). The C.T.C. machine is situated at the end of the system. Some time-code apparatus are now being installed (35 stations).

U.S.A. (A.A.R.) : No technical limit of the capacity of the telecontrol system adopted. The limit is only determined by economic considerations. The capacity is not affected by the situation of the Central Post.

According to the publications of the Signal Companies of U.S.A. the number of stations and number of controls (and indications) depends on the local requirements, as the systems are developed in such a way that it is possible to reduce the maximum number of stations for the benefit of more controls per station.

Question 6. — *What distance can you cover with your system of telecontrol without having to use installations with a carrying frequency?*

Ans. 6. — The New Zealand Government Railways :

No limits given. The most distant installation is at present situated 24 miles away.

U.S.A. (A.A.R.) : Present installations up to 284 miles, however, it can be further.

Question 7a). — *What type of transmission do you generally use for the operation and control (D.C., A.C., sound selection, induction selection, wireless or other)?*

Ans. 7a). — Direct current.

Question 7b). — *How many impulses are there in the code used? Do these impulses differ in frequency, in polarity or in duration?*

Ans. 7b). — Rhodesia Railways: 48 forward and reverse impulses.

The New Zealand Government Railways: 8 impulses. Intelligence carried out by pulsing on any or all of three wires. The Westinghouse circuit code system.

U.S.A. (A.A.R.): 16 or more impulses for control and indications of varying duration. Time Code System. According to the signal companies other systems are also used though apparently most installations have Time Code.

Question 7c). — *Do you use a coded system with a chain of relays or a rotary selector?*

Ans. 7c). — Chain of relays are used.

Question 7d). — *Is the transmission line under tension or not when it is not transmitting?*

Are the insulation and continuity of the transmission line permanently controlled by the Central Post?

Ans. 7d). — The transmission line is under tension and permanently controlled.

Question 7e). — *Is the selector relay of each Local Post connected in series or in derivation on the transmission line?*

Ans. 7e. — Rhodesia Railways: Parallel. The New Zealand Railways: Series.

U.S.A. (A.A.R.): At some installations in parallel, at other installations in series.

Question 8. — *Are there any systems at a carrying frequency? (We are not concerned in this instance with the well known system in which the track is divided into various sections which are fed directly, and in which the furthest off sections are retransmitted onto the nearest circuits by means of the carrying frequency.) Are there any systems in which for example a different carrying frequency is given to each station or each apparatus?*

Ans. 8. — U.S.A. (A.A.R.): 1st question: Yes;

2nd question: Yes.

Question 9a), i. — *Is there interlocking between the points and signals. At the local control post?*

Ans. 9a), i. — Yes.

Question 9a), ii. — *Partly at the Local Post and partly at the Central Post?*

Ans. 9a), ii. — Rhodesia Railways and the New Zealand Government Railways: No.

U.S.A. (A.A.R.): Yes. No security interlocking between points and signals at a Local Control Post is placed at the Central Post, as far as the writer is informed.

Question 9a), iii. — *At the Central post?*

Ans. 9a), iii. — U.S.A. (A.A.R.): Yes, when required.

Question 9b). — *Are the points operated by setting up a route or can they be operated individually? In the first case, do you consider that individual repetition of the working of the points is essential?*

Ans. 9b). — Rhodesia Railways and the New Zealand Government Railways operate the points individually. New Zealand does not consider individual repetition essential but it is standard practice.

U.S.A. (A.A.R.): Both methods of operating the points are in use. Individual repetition of the points is considered essential.

Question 9c). — *In the case of shunting movements, are the points operated separately? Are they then operated locally or from the Central Post?*

Ans. 9c). — Rhodesia Railways: Points operated separately by train crew for shunting.

The New Zealand Government Railways: Under shunting condition, the central operator gives over control of the whole of the station to a local operator i.e. all signals and points thus controlled at the Local Control Post.

U.S.A. (A.A.R.) : The answer is « both or either » to both questions.

Question 10a). — *What operating and control apparatus is there on the panel of the Central Post and how are they arranged, geographically or in some other order?*

Ans. 10a. — Description of New Zealand C.T.C.: Control panel is comprised of track diagram with track occupancy indication lamp under which are three horizontal rows of switches controlling signals, points and releases. Below these are push buttons to initiate control operations. The panel is mounted in a cubicle which houses all relay equipment. Stations on the diagram are arranged in geographical order and vertical rows of three keys are approximately vertically below the equipment shown on the diagram which they control. This seems to be like most American installations.

Rhodesia Railways and U.S.A. (A.A.R.) (generally) use free moving levers and push buttons geographically arranged.

Question 10b). — *Are only the state of being in movement or the state of being out of order of the points signalled or else the position plus or minus of the blades of the point also transmitted to the Central Post? If the points are accidentally trailed is this also signalled to the post?*

Ans. 10b). — Only the position of the points are indicated (normal or reverse) not the individual position of the blades. Indication is given if points are run through.

Question 11. — *How many conductors do you make use of in your telecontrol system (for control and indication)?*

Do you make use of cables or overhead circuits (insulated or otherwise)? What is the diameter or section of these conductors?

Ans. 11. — Rhodesia Railways: Two wires used for control and indication.

The New Zealand Government Railways: Three wires used — run in overhead unisolated wire of size 200 lbs. per mile 11 1/2 S.W.G. hard drawn copper. Some shed tunnel sections are in cable.

U.S.A. (A.A.R.) : Two or three conductors. Cables or overhead lines are used depending on the local requirements. The dimentions of the wires are No. 6, 8 or 9 B and S gage.

Question 12. — *What is the degree of user of these conductors? Can a pair of conductors be used simultaneously for the operation and control of different points and crossings?*

Are the same pairs of conductors used successively for control and indication or are the lines only used for a single function? In what cases do you use more than a pair of conductors?

Ans. 12. — The expression « degree of user » is by the writer supposed to mean « Utilization ».

Rhodesia Railways and the New Zealand Government Railways: The applied systems are simplex (one control or indication at any one time, control having preference over indications).

U.S.A. (A.A.R.) : 1st question: Conductors carry simultaneously the D.C. code, carrier codes, telegraph and telephone;

2nd question: Yes, by the use of carrier superimposed on D.C. code;

3rd question: The same two wires carry the control for operating and indicating the switches, signals and other functions (though some installations of duplex system have more wires — writer's remark);

4th question : Where functions are controlled by direct wire.

Question 13. — *What measures of protection have you used on D.C. overhead telecontrol lines against disturbances and false transmissions caused by short circuits or atmospheric discharges in the case of storms, etc.?*

Or do you accept the risk of discharges in the case of storms occurring?

Ans. 13. — Lightning arresters are used.

Rhodesia Railways have from experience found that atmospheric discharges do not cause false transmissions.

U.S.A. (A.A.R.) : 1st question : Proper maintenance of made grounds and special circuits to tie in line with ground, in case of one line wire breaking;

2nd question : Wayside safety circuits prevent false transmissions from operating any function unsafely.

Question 14. — *Do you use D.C. transmission devices on electrified lines using A.C. supply, and how do you protect them from stray voltages?*

Ans. 14. — U.S.A. (A.A.R.): D.C. transmission devices are used and protected by valves where considered necessary.

Question 15. — *Over what distances do you make use of multiple user of the transmission circuits?*

Ans. 15. — (« Make use of multiple user » supposed to be equal to « permit multiple utilization of ».)

Rhodesia Railways : Line wires used for C.T.C. only.

U.S.A. (A.A.R.) : Circuits of 200 to 300 miles in length. However, with carrier control it is possible to control any length of territory over a two-wire line.

Question 16a). — *Are the controls and indications transmitted by a telecontrol installation limited in number, or is it possible to increase the capacity of the installation as required?*

Ans. 16a). — U.S.A. (A.A.R.) : Can be increased.

Question 16b). — *What is the duration of transmission of a control and an indication?*

Ans. 16b). — Rhodesia Railways : 3 1/2 sec.

U.S.A. (A.A.R.) : Systems vary 1 to 8 sec.

Question 16c). — *Is a « control » controlled (checked) before it is carried out? What steps are taken to make sure that dispensing with a preliminary control will not allow a control — wrongly received to be carried out?*

Ans. 16c). — U.S.A. (A.A.R.): Yes, indications are received at control point. As far as the writer is informed, no special information is exchanged between the local post and the C.T.C.-machine after the dispatching of the control code, before the control is carried out — (as used by European systems).

Question 16d). — *Are the controls recorded and kept? In what order are the controls transmitted?*

Ans. 16d). — The question has not been understood by the Administrations. The question should be read as follows : are the controls registered and stored? The answer should certainly be that the controls are stored and are released successively in an arbitrary order determined by the circuits in the control machine. The highest priority usually given to the control set apart to the station nearest to the control-machine. Normally no registration of orders except setting of signals which are sometimes recorded by the train graph-recorder.

Question 16e). — *How are the indications recorded?*

Ans. 16e). — U.S.A. (A.A.R.) : Not generally recorded. Though the running in and out of the sidings are often recorded by the train graph-recorder (writer's remark).

Question 16f). — *What method do you use if several indications use the same circuit simultaneously ?*

Ans. 16f). — U.S.A. (A.A.R.) : Storage will be transmitted in accord with station assignment.

Question 17a). — *What types of relays are used ? Telephone relays with neutral and polarised armature ? What is the size of the magnet tie system, coils, cores and armatures ? What is the maximum number of contacts and what types of contacts are used ?*

Ans. 17a). — Rhodesia Railways : Control equipment has telephone relays with neutral armatures, all relays of British Post Office pattern as used on telephone exchanges.

The New Zealand Government Railways: Relays in line circuits are of special type with a spring assisted de-energised position. Coils are approximately 20 ohms with 2 change-over platinum contacts. Other relays are of telephone type with a maximum of approximately 9 German silver contacts. Coil resistance of the latter suits the maximum contact pile.

U.S.A. (A.A.R.) : Non-vital type — similar to telephone type of neutral, polarized, biased neutral, magnetic stick, etc. 8 to 24 V. Size varies according to requirements. Maximum contact arrangement 20. Silver to silver contacts.

Question 17b). — *Have the relays brazed contacts, interchangeable screw or knife edge contacts ?*

Ans. 17b). — Rhodesia Railways use braze contacts. The New Zealand Government Railways : Relays in line circuits have brazed contacts with screw adjustment. All other relays have telephone type riveted contacts. All contacts are of the self wiping type.

U.S.A. (A.A.R.) : Round head silver riveted.

Question 18. — *D.C. coded systems work slowly. Are these systems also used on lines with heavy traffic, and in that case, what methods are used to meet the requirements of this traffic ?*

Ans. 18. — Rhodesia Railways and the New Zealand Government Railways : D.C. systems always used.

U.S.A. (A.A.R.) : If speed of code is a factor account of dense traffic, fast code system is used, or separate office unit with individual code lines.

Question 19. — *In telecontrolled stations have you direct or indirect locking points and for what reasons ? Who keeps the key ? Is there a telecontrolled electric lock ? If there is no such lock, is it possible to work a point directly or must permission be obtained by telephone ?*

Ans. 19. — Rhodesia Railways : Direct locking provided. Points can be hand operated by emergency key carried on locomotive once permission is obtained via telephone from control and necessary paper order issued.

The New Zealand Government Railways: All main line points have direct control via electric points machine. Points off loops and subsidiary main line points have electric locks released by telecontrol. Emergency hand control directed by telephone.

U.S.A. (A.A.R.) : 1st question : Points are electric locked — either automatic or controlled from control point;

2nd question : There is no key;

3rd question : On installations not electric locked, telephone permission to use points must be obtained;

4th question : On some lines points can be worked directly, on others permission must be obtained by telephone.

Question 20. — *By what system are the telecontrolled apparatus fed (relays, signals, motors for the points, etc.)?*

Ans. 20. — Rhodesia Railways use primary cell or petrol generators where no power supply is available.

The New Zealand Government Railways and U.S.A. (A.A.R.) : Power supply by storage batteries — trickle charged by commercial power. The batteries of the New Zealand C.T.C. are 24 V center tapped wherever required for 12 V equipment.

Question 21. — *Do you use electric heating or some other method of heating for telecontrolled points? How do these devices work and are the results obtained satisfactory?*

Ans. 21. — U.S.A. (A.A.R.): Yes, electric or gas switch heaters. Remotely or locally controlled — satisfactory.

Question 22. — *Are the telecontrolled posts equipped with a local control device (control table or some other such)?*

Ans. 22. — Rhodesia Railways : No.

The New Zealand Government Railways and U.S.A. (A.A.R.) : Yes.

Question 23. — *Amongst the breakdowns listed below, which are signalled to the central post and which are not? Give the annual number of each type of breakdowns :*

a) *breakdowns in transmission?*

b) *breakdowns of the points?*

c) *signal lights burnt out?*

d) *failure of the relays of the local post to function?*

e) *interruption of the current?*

f) *other breakdowns?*

Ans. 23. — Rhodesia Railways : Breakdowns vary during dry season, breakdowns are infrequent, but during the rainy season breakdowns are fairly frequent. Cause no serious delay to traffic movements.

The New Zealand Government Railways: *b*), *d*) and *e*) will be indicated at the control point. Breakdowns : *a*) 7, *b*) 4, *c*) 10. *d*) 7, *e*) 8. *f*) 11.

U.S.A. (A.A.R.) : *a*) yes, indirectly, *b*) yes, *c*) no, *d*) yes, indirectly, *e*) yes, *f*) track circuit interruptions and failure of any function to respond. The annual numbers of breakdowns are not available.

Question 24. — *Does a breakdown in a telecontrol line or a telecontrol post affect the other telecontrolled posts?*

Ans. 24. — Yes. U.S.A. (A.A.R) adds : If same line is utilized for 2 or more zones. Most of the American installations have the possibility of cutting out the telecontrolled post if a breakdown occurs, in order not to disturb the operation of more distant stations (writer's remark).

Question 25 :

a) *How are the points and signals operated when anything goes wrong with the long distance telecontrol?*

b) *Have you made provision for the operation of the points and signals locally by disconnecting the telecontrol or by connecting the signals of the through roads for through running? Can these changes in the connections be carried out in terms of the direction of the traffic or even independently for entering and leaving?*

Ans. 25a), b). — Rhodesia Railways : The crew operates the points by emergency key (see 19 above). Signal are passed at danger only on written authority from control, which is obtained by telephone.

The New Zealand Government Railways: Points may be hand-operated but signals must be passed at stop under direction by train order.

U.S.A. (A.A.R.) : Points hand operated, by either crank or handle. Signals not operated. Telephone permission given or

train order issued, except at locations where complete manual control panel is provided.

Question 26a). — *What measures are taken, when as the result of a breakdown a stop signal guarding the entrance or exit of a station cannot be cleared? Who gives the order authorising running past it at danger and by what means?*

Ans. 26a). — Rhodesia Railways and the New Zealand Government Railways: Authorisation to pass any signal is given by the telecontrol operator. The authority is given on a written form which is filled in by train crew on dictation by phone by the telecontrol operator.

U.S.A. (A.A.R.): Dispatcher by telephone issues instructions or train orders to pass stop signal.

Question 26b). — *When, owing to a breakdown, a telecontrolled point does not correspond to the order given, how and by whom is it operated and with what guarantees is this operation done?*

Ans. 26b). — Rhodesia Railways and U.S.A. (A.A.R.): By train crews — (U.S.A.) special instructions for operation are posted at control points.

The New Zealand Government Railways: The controlled point may be operated by a member of traffic staff sent under emergency to that point. If the duration of breakdown is short, however, the train crew may pilot the train through the station using method (26*a*) above. The special traffic operator sent to the point may permit a train to enter the station on verbal authorisation by the telecontrol operator, but he must have written authorisation as in (26*a*) above, before the train is permitted to leave the station.

Question 27. — a) *How are the routes freed when:*

i) *a change of route is necessary?*

ii) *there is a breakdown?*

Has provision been made for an order for the urgent freeing of a route? What time elapses after the signal goes to danger before the route is automatically freed? Is this also provided on lines where the trains follow one another very closely?

Ans. 27a), i and a), ii. — The routes are freed after a predetermined time.

Rhodesia Railways: 2 min.

The New Zealand Government Railways: 1 1/2 min generally.

U.S.A. (A.A.R.): Time element depends upon signal spacing, train speed and tonnage, etc. Controls for urgent freeing are provided on all lines.

Question 27b). — *What technical telecontrol steps are taken to free a route urgently? Have route controlling devices time relays which only allow the freeing of the route?*

Ans. 27b). — Rhodesia Railways and U.S.A. (A.A.R.): Time delays in all cases.

The New Zealand Government Railways: Time delays are only imposed if a train is actually approaching the signal.

Question 28. — *What steps must the head of a C.T.C. post take if anything goes wrong with the cable and interrupts the telecontrol? (No impulses go out, no repetition comes in.)*

Ans. 28. — Rhodesia Railways and the New Zealand Government Railways: Call maintenance staff. In meantime keeps traffic moving by issue of written orders to pass signals at danger.

U.S.A. (A.A.R.): Notify dispatcher who in turn notifies maintenance crew.

Question 29a). — *Does the head of the Central Post keep graphs showing the way the traffic operations take place? Does he insert the announcements received on the graphs representing the line?*

Ans. 29a). — Yes.

Question 29b). — *Is there any automatic equipment recording the running of the trains? Of what type? (Short description.)*

Ans. 29b). — Yes. Train graph pen recorder.

Question 29c). — *What section of track are controlled by the equipment recording the running of the trains? Is the direction of running specially shown?*

Ans. 29c). — Rhodesia Railways and New Zealand Railways: Entrance and exit only shown, no direction given, this checked by train number.

U.S.A. (A.A.R.): Track circuit at OS points are recorded, running direction is shown. By marking the setting of home signals (writer's remark).

Question 30. — *In the case of double track lines, how do you safeguard passengers who have to cross over the other line to board or leave a train?*

Ans. 30. — The New Zealand Government Railways use overbridges in some cases.

U.S.A. (A.A.R.): Rules do not permit two trains in station at same time. Under or overpasses frequently used.

Question 31:

a) *On lines equipped with C.T.C., are the number and type of the trains announced in any way to the Central Post?*

b) *Are the number and the type of the trains shown optically on the control table of the Central Post at the same time as the occupation of a section of track?*

c) *Do you announce the number of the trains and its type to the stations or only the type or only the destination?*

Ans. 31a), b) and c). — None of the Administrations have train-number indications according to the meaning of the questions, which do not include the use of normal train graph-recorders. In the train-number equipment thought of the « number » of the train follows the train continuously (automatically) from one track section to the next track section on the track diagram. The number of the trains are manually set up (dialled) at the beginning of the C.T.C. section or at stations where they may start running into the C.T.C. section (C.T.C., Nürnberg, Regensburg, Germany).

Question 32. — *What telephone connections have you made between the Central post and:*

a) *the local post;*

b) *the signals;*

c) *the maintenance men?*

Ans. 32a), b) and c). — Rhodesia Railways: *a*) and *b*) calling telephones; *c*) selector telephones.

U.S.A. (A.A.R.): *a*) and *b*) fixed phone; *c*) portable phone.

The New Zealand Government Railways: *a*) the telecontrol operator has a separate telephone system to communicate with stations. The operator may call any station and a special light indication shows outside the station building; *b*) telephones near all departure signals entering block sections; *c*) the maintenance men use telecommunications as in *a*).

Telephones (non selected) are also placed at strategic points along the permanent way.

Question 33. — *What organization have you set up for the maintenance and conservation of the installation? How many men are needed for the systematic overhaul and how is this carried out? How are breakdowns and possible damage repaired at the Central Post, in the transmission line and in the Local Post?*

Ans. 33. — U.S.A. (A.A.R.): Maintenance organization does not differ from any other signal system.

Rhodesia Railways : Five maintenance men required on 110 miles section. All maintenance staff equipped with road transport.

The New Zealand Government Railways: Maintenance is carried out by normal outdoor maintenance staff, their job being the maintenance and repair of overhead lines and interlocking and the replacement and interchange of telecontrol relay equipment. Telecontrols relay equipment is kept in sealed housings and is maintained by staff in depots. A maintainer and assistant normally covers about 20-30 miles, while at the depot one man using test equipment special to the system can usually repair and test equipment in a 30 miles section.

B. — ELECTRIC WORKING AND CONTROL DEVICES FOR HINGED AND « FLEXIBLE » POINTS AND SWITCHES. CONTROL OF ACCIDENTAL TRAILING OF THE SWITCH BLADE.

Preface to Part B.

In the following there is given no difference of meaning to the words « point » and « switch ».

The writer has tried to give the answers of the Administrations a general form. But as practices often differ, the writer has found it necessary in most cases to report several answers on the same question. Besides it will probably be of interest to know exactly how the different Administrations solve their problems. The answers in most cases are not reported in their original form, but are changed and often shortened to be able to render the answers of several Administrations in one answer. Administrations not mentioned in the answers of this report have either given no answer or the question has not been understood. When there is given just one answer this concerns all Administrations and their names are therefore not mentioned.

Points.

Question 1a. — *Do you use points with or without locking of the switch blade and why? (By locking of the switch blade is meant a device which locks each of the blades or the closed blade only, unlike a pull-rod lock which locks the stretcher rod of the blades.)*

Ans. 1a. — U.S.A. (A.A.R.), the New Zealand Government Railways and the Railway Board, India, don't lock the blades individually.

U.S.A. (A.A.R.) don't consider it necessary. The other Administrations lock the switch blades individually. Denmark and Sweden state that the blades are locked either at the switch (hooklock) or in the switch-machine though Sweden mostly has the locking in the switch-machine. British Railways and Norway do the locking in the switch-machine.

Question 1b). — *Is the electric device for operating the points fixed or movable and why?*

Ans. 1b). — 1st question : All Administrations except British Railways use fixed electric switch-machines. Denmark has also some movable electric switch-machines. The answer of British Railways to question *b*) and the following question *c*) to *f*) was : Not applicable.

2nd question : U.S.A. (A.A.R.) : To maintain proper throw.

The Railway Board, India : To enable the switch blades to be locked quite rigidly.

Question 1c). — *What is the sweep of the switch blades and the stroke of the motor when points with blade lock are used?*

Ans. 1c). — U.S.A. (A.A.R.) : Sweep 4 3/4 inches, 12 inches back from point, stroke 6 inches.

Ceylon Government Railway : Sweep 4 1/2 inches, stroke 4 1/2 inches.

Denmark : Sweep 160 mm (6.29 in.) (220 mm [8.66 in.] when hooklocked).

Finland : Sweep 169 mm (6.65 in.), stroke 240 mm (9.45 in.).

The New Zealand Government Railways: Sweep 4 inches, stroke 8 inches.

Norway : Sweep 170 mm (6.69 in.), stroke 220 mm (8.66 in.).

Rhodesia Railways : Sweep 4 inches, stroke 10 inches.

Sweden : Sweep 170 mm (6.69 in.), stroke 170 mm (250 mm [9.84 in.] when hooklocked).

The Railway Board, India : Sweep 4 1/2 inches for BG points and 4 inches for MG points, stroke 6 inches.

Question 1d). — *What sort of blade lock do you use?*

Ans. 1d). — U.S.A. (A.A.R.), the Ceylon Government Railway, the New Zealand Government Railways and the Railway Board, India, use plunger lock.

Rhodesia Railway use British Standard facing point lock.

Denmark and Sweden use hooklocks and locks incorporated in the switch-machines.

Norway use locks incorporated in the switch-machines.

Question 1e). — *How is the stability of the position of the blade assured when points without blade lock are used?*

Ans. 1e). — U.S.A. (A.A.R.) and the New Zealand Government Railways : The stability is assured electrically — point detector.

The answer of the Railway Board, India : The stability is assured by the stretcher rod rigidly connected to the point.

Question 1f). — *What other types of lock do you use?*

Ans. 1f). — U.S.A. (A.A.R.), Ceylon Government Railway, Rhodesia Railways and the Railway Board, India, use no other type.

Denmark and Norway : Subsidiary switches sometimes have special locks with electrically released key.

The answer of Finland : « Wedge locking (normally used), articulated locking or hooklocking. »

The New Zealand Government Railways: Where electrically released switchlocks are used on subsidiary points, a plunger type lock acting directly on a rod tying the point blades, is employed.

Sweden : If the speed of the trains exceeds 100 km/h an additional motor driven lock locks the rods of the switch-machine (makes it untrailable).

Question 2a). — *Are there special locks for trailable points and derailing switches?*

Ans. 2a). — U.S.A. (A.A.R.) : Yes. (The points are normally untrailable.)

The New Zealand Government Railways don't use trailable points.

The other Administrations answered : No.

Question 2b). — *Are points with locks trailable or is the lock fixed?*

Ans. 2b). — Denmark, Finland, Norway and Sweden (except 1*f*) use trailable points.

The other Administrations have none trailable points (exception U.S.A. per 2*a*) above).

Question 2c). — *Is the locking device mounted on the operating mechanism or is it independent of the latter?*

Ans. 2c). — U.S.A. (A.A.R.), British Railways, Denmark, Finland, Norway, Sweden and the Railway Board, India, answered that it can be either. As for Sweden lock mentioned in 1*f*) above is mounted in operating mechanism.

The Ceylon Government Railway and Rhodesia Railways have independent locking. The New Zealand Government Railways have the lock mounted in the operating mechanism.

Control of points.

Question 3. — *The following safety measures are taken as being included in the control of electrically operated points:*

a) *internal electric control that the bar or part that moves the two blades of the point connected by a rigid or articulated stem, has travelled its whole stroke;*

b) *internal electric control that the two bars which move the two blades independently when these are not rigidly connected, have completed their respective strokes;*

c) *internal electric control that the bars or moveable parts mentioned under* a) *and* b) *above are still locked after they have completed their stroke. State in the case of an independent bar for each blade, whether the blade in contact with the stock rail alone is locked;*

d) *control by means of electric contacts worked directly by the blades, that the point of the fixed blade is in the correct position. Please indicate whether this verification is done for each of the two positions of the points (through road and turnout road) or only for the former;*

e) *control by means of contacts as under* d) *of the correct position of the point of the open blade;*

f) *mechanical locking of the points of the blades, worked by the own working of the point by means of a supplementary stroke of the bar moving the blades (for example hooklock).*

How many of the checks described under a), b), c), e) *and* f) *or others not mentioned either alone or in conjunction with each other do you use in your up-to-date installations of facing points and crossings (according to whether they are on the main lines, secondary lines or marshalling groups), and for trailing points and crossings, and what are the maximum speeds authorized for running through facing points?*

Ans. 3a). — Control according to 3*a*) generally used.

Ans. 3b). — U. S. A. (A. A. R.), British Railways and the New Zealand Government Railways: Control according to 3*b*) not used.

Denmark, Finland, Norway and Sweden: In use.

Ans. 3c). — U. S. A. (A. A. R.), British Railways, Finland, Rhodesia Railways and Sweden: Locking according to *c*).

Denmark and Norway: Only blade in contact with stock rail is locked.

The Railway Board, India: Both bars locked.

The New Zealand Government Railways: Not used.

Ans. 3d). — Control according to *d*) generally used for both positions.

Ans. 3e). — Control according to *e*) generally used.

Ans. 3f). — U. S. A. (A. A. R.), British Railways, and Norway: No locking according to *f*).

Denmark, the New Zealand Government Railways, Sweden and the Railway Board, India, have locking according to *f*).

Supplementary answers to question 3.

Number of checks:

U. S. A. (A. A. R.), The New Zealand Government Railways, Norway and Sweden use 5 of the described checks.

British Railways and Ceylon Government Railways use 4 of do.

Denmark use 6 of do.

The Railway Board, India: On main lines checks according to *a*), *c*), *d*), *e*) and *f*). In marshalling yards according to *a*).

Speed limits:

U.S.A. (A.A.R), British Railways, Ceylon Government Railway, Denmark, Norway,

Sweden and the Railway Board, India, have no speed limitations other than the authorized.

Finland : Speed limit through running :

43 kg/m and 60 kg/m points : 85 km per h (53 m.p.h.) ;

30 kg/m points : 75 km per h (47 m.p.h.) ;

22 kg/m and 25 kg/m points : 65 km per h (40 m.p.h.).

Speed limit turnout position is 35 km (21 miles) per hour independent of rail weight.

The New Zealand Government Railways: Speed limit facing points :

1 in 7 1/2 and 9 turnouts : 15 m. per h;

1 in 12 and 9 turnouts : 30 m. per h.

Question 4. — *When do you use direct control of the points of the two blades? Do you prefer to use a single apparatus in which the two blades are checked by means of the stems?*

Ans. 4. — U.S.A. (A.A.R.) and Ceylon Government Railway have direct control. Single apparatus in all cases (separate switch circuit controller).

The answer of British Railways : Combined point detectors are generally used.

Denmark, Finland, Norway and Sweden : Direct control, control inside switch-machine.

The Railway Board, India : Direct control of points is used where normal control provided fails. Single apparatus, blades checked by means of stems.

Question 5a). — *Do you use the same arrangements or different devices for the electric operation :*

i) *of normal points?*

ii) *of points difficult to operate?*

iii) *of points on the slopes of gravity marshalling yards?*

Ans. 5a). — U.S.A. (A.A.R.) use different devices in all above mentioned cases.

British Railways and the Railway Board, India : In marshalling yards a quicker type of machine is used (India remarks : with no locking).

Denmark, Finland, the New Zealand Government Railways, Norway, Rhodesia Railways and Sweden use the same device.

Finland remarks : Long points (1 : 15) have control contacts in the middle of the blades.

Question 5b). — *What force, operating time and controlling force are ordered for these three types of points, and what are the other requirements prescribed?*

Ans 5b). — *Normal points :*

U.S.A. (A.A.R.) : All mechanisms capable of pulling : 3 800 lbs. at end stroke without damage. Operating time of first range low speed mechanisms maximum : 30 sec (normal voltage : 20 V) and of first range high speed mechanisms maximum : 15 sec (normal voltage : 20 V) and of second range mechanisms maximum : 4.5 sec (normal voltage : 110 V). Mechanisms in locked position shall be capable of withstanding stress equivalent to a thrust of 20 000 lbs. either on the switch operating or locking connection.

British Railways : Operating time : 2 to 3 sec.

Ceylon Government Railway : Force : 400 lbs., 7 sec.

Denmark : Force : 350 kg, 2 to 5 sec, 500 kg.

Finland : Force : 200 to 250 kg, 2 to 3 sec, 400 to 500 kg.

The New Zealand Government Railways: According to standard requirements : operations adequate for all cases.

Norway : 250 to 300 kg, 3 sec, 500 kg.

Rhodesia Railways : Operating time : 3.5 sec (30 V machine), 1.6 sec (110 V machine).

Sweden : Force : 400 kg, 2.5 sec.

The Railway Board, India : Force of 110 V D.C. machines : 2 500 lbs.; force of 110 V A.C. machines : 1 500 lbs. Operating

time of both are: 2.5 to 4 sec. Force of low voltage: 30 40 V, 1 000 to 1 500 lbs. Operating time: 6 to 9 sec.

Points of marshalling yards.

U.S.A. (A.A.R.) : Special quick-acting trailable without locking: 1 200 lbs. min. force, 2 000 lb. yielding stress. 0.6 sec.

British Railways and the Railway Board, India: Operating time 1 sec.

Sweden: Operating time: 0.75 sec.

Question 5c). — *What are the different gear ratios used for these three same sorts of points?*

Ans. 5c). — The Administrations did not understand the question.

Question 5d). — *Do you use different operating devices for articulated points and for flexible points, and why?*

Ans. 5d). — U.S.A. (A.A.R.) : Yes, elastic points require different devices.

Finland have no flexible points.

The other Administrations don't use different devices.

Question 5e). — *Can the operating device be installed at will on either side of the point? Is it rectilinear or angular?*

Ans. 5e). — 1st question: Yes.

2nd question: U.S.A. (A.A.R.) : Either.

British Railways and Sweden: Fixed in line with track.

Ceylon Government Railway, Denmark, the New Zealand Government Railways and Railway Board, India, use rodding rectilinear.

Question 5f). — *When the motors are supplied with current by local batteries what is the allowable operating time and what voltage are used?*

Ans. 5f). — 1st question: U.S.A. (A.A.R): 2 to 15 sec.

British Railways: 4 to 5 sec.

Ceylon Government Railway: 7 sec.

The New Zealand Government Railways: 5 sec.

Rhodesia Railways: 3.5 sec.

Sweden: 2.5 sec.

Railway Board, India: 6 to 9 sec.

2nd question: U.S.A. (A.A.R.) : 20 to 110 V.

British Railways: 30 V.

Ceylon Government Railway: 48 V.

Denmark: No batteries.

Finland: 136 V.

The New Zealand Government Railways: 24 V.

Norway: No batteries.

Rhodesia Railways: 30 V.

Sweden: 110 V (batteries not generally used).

Railway Board, India: 30 to 40 V.

Question 6a). — *What voltage and what type of current do you use for operating and controlling points in the case of steam traction, and in the case of electric traction D.C. and A.C. supplies?*

Ans. 6a). — U. S. A. (A. A. R.) : 20 to 110 V D.C. or A.C., in both cases.

Ceylon Government Railway: Broad gauge: 110 V A.C. Narrow gauge: 48 V D.C. No electrification.

Denmark: 136 V D.C. or 220 V D.C. (last tension preferred), controlling current: 36 V D.C. in both cases. (Either steam or electric.)

Finland: 136 V D.C. or 220 V A.C., 3 phase-A.C. of 380/220 V is designed to be used. No electrification.

The New Zealand Government Railways: 24 V D.C. and 110 V A.C. in both cases.

Norway: 220 V A.C. Controlling current: 36 V D.C. in both cases.

Rhodesia Railways: 30 V or 110 V. No electrification.

Sweden: 220 V D.C. Controlling current: 110 V A.C.or 24 V D.C. in both cases.

Railway Board, India: Steam traction: 110 V D.C. or A.C. or 30 V D.C. By electric traction: 110 V D.C. or A.C.

Question 6b). — *Is the current voluntarily reduced when the motor of the point begins to run?*

Ans. 6b). — Finland, the New Zealand Government Railways, Norway and Sweden: No.

The other Administrations answered: Yes.

Question 6c). — *How many amperes does the motor absorb on starting and how much whilst running?*

Ans. 6c). — U.S.A. (A.A.R.): Low voltage, start: 20 A; running: 7 to 10 A. High voltage, start: 12 A; running: 4 to 7 A.

British Railways: Start: 5 to 10 A; running: 5 A.

Ceylon Government Railway: A. C. motor; start: 10 A; running: 7 A; D.C. motor; start: 4.5 A; running: 3 A.

Denmark: 220 V D.C. motor; start: 10 to 15 A; running: 3 to 5 A; 136 V D.C. motor; start: 15 to 20 A; running: 5 to 7 A.

Finland: 136 V D.C. motor; running: 4 to 6 A; 220 V A.C. motor; start: 10 A; running: 2.5 to 5 A.

The New Zealand Government Railways: D.C. and A.C.; start: 12 A; running: 5 to 7 A.

Norway: 220 V A.C. motor; start: 5 to 7 A; running: 3 A.

Rhodesia Railway: 30 V motor; start: 7 A; running: 4.5 A; 110 V motor; start: 4.4 A; running: 3 A.

Sweden: 220 V D.C. motor; start: 3.5 A; running: 2.5 A.

Railway Board, India: start: 5 to 7 A; running: 4 to 5 A.

Question 6d). — *Is the working current cut by the operating device or by the interlocking post? Are there control contacts on the operating device or not?*

Ans. 6d). — 1st question: By the operating device;

2nd question: U.S.A. (A.A.R.), Ceylon Government Railway, Denmark, the New-Zealand Government Railways, Norway, Sweden and Railway Board, India, have control contacts on the operating device.

Question 6e).— *Do you stipulate motors that can operate on various kinds of current?*

Ans. 6e). — U.S.A. (A.A.R.) and Rhodesia Railways: Yes.

The other Administrations: No.

Question 6f). — *Is the current for working the points taken to the operating devices of the points by a circular circuit, or is there a special circuit bringing the current from the interlocking post to each point?*

Ans. 6f). — U.S.A. (A.A.R.): Both types of circuits.

The answers of British Railways: Independent circuit.

The New Zealand Government Railways: From common power supply by contactors operated from interlocking.

The other Administrations: Special circuit from interlocking post.

Question 7a). — *Does the motor run in either direction, or has the operating device to be reversed?*

Ans. 7a). — The motor runs in either direction.

Question 7b). — *Do you use an operating device with worm or straight gear? Are the teeth straight, oblique, or helicoidal?*

Ans. 7b). — 1st question: U.S.A. (A.A.R.), Denmark, Finland and Norway use both worm and straight gear.

British Railways, Ceylon Government Railway and Rhodesia Railways use worm gear.

The New Zealand Government Railways: Worm or level gear.

Sweden use straight gear.

Railway Board, India : Points machines for operation of points and lock generally employ straight gears with level wheel, points machines for operation of points only employ worm wheel;

2nd question : U.S.A. A.A.R.) and Denmark use various types of teeth. British Railways use oblique teeth.

Ceylon Government Railway : A. C. motor, straight teeth; D.C. motor, oblique teeth.

Question 7c). — *What transmission arrangement do you use?*

Ans. 7c). — The answer to this question was :

U.S.A. (A.A.R.) : Clutch and direct.

British Railways : Cam plate.

Ceylon Government Railway : Rodding.

The New Zealand Government Railways: Direct rigid rodding.

Rhodesia Railway and Sweden : Gear transmission.

Question 8. — *In what cases and with what objets in view have you fitted in a local manoeuvre device, also electrical in the case of points operated electrically from a distance? Does this manoeuvre organ require the consent of the Post to be previously transmitted electrically? When the local electric manoeuvre organ is used, do the electric interlocking safety devices work and does the Central Post get a verification of the movements of the points?*

Ans. 8. — U.S.A. (A.A.R.) : No comment; not general practice (the question has probably not been understood, writer's remark).

Denmark : Local manoeuvre fitted when frequent shunting. Points are interlocked with signals. At new installations, positions of the points are indicated at the Central Post.

Finland : Local manoeuvre on small yards operated by push buttons. No position indication at the Central Post when local manoeuvre is permitted.

The New Zealand Government Railways: Electric switchlocks released from the Central Post are used on subsidiary points, i.e. on points through which moves are not governed by signals. The release is given from the Central Post and the points are interlocked normal with any signals. Indication given is that the release given to the switchlock has been accepted.

Norway and Sweden : Local manoeuvre which has to be released from Central Post.

Question 9a). — *In urgent cases (interruption of the current, damage to the motor, overhaul of the equipment, etc.) is there some arrangement to enable the points to be hand operated incorporated in the electrical mechanism of the points?*

Ans. 9a). — Yes.

Question 9b). — *If hand-operated, are the cables supplying the current cut out :*

i) *obligatorily?*

ii) *possibly?*

iii) *how is this done?*

Ans. 9b). — U. S. A. (A. A. R.), British Railways, Ceylon Government Railway, the New Zealand Government Railways, and Rhodesia Railways : Obligatory, by crank contact.

Denmark, Finland and Norway : Not obligatorily. Hand-operation must be permitted, current cut out at the Central Post.

Sweden : Obligatorily. Point operated by crank normally kept in the Central Post where there is a contact breaking the current when crank is removed.

Railway Board, India : Obligatorily. A contact breaks the current when the cap is removed for inserting the hand crank.

Question 9c). — *If the points are operated by hand, must their position be advised to the signal box?*

Ans. 9c). — Finland, the New Zealand Government Railways, Norway and Rhodesia Railways answered : no.

The other Administrations : Yes.

Question 9d). — *How do you assure the correspondence between the points and the route when a point whose electrical control is out of order is worked by hand ?*

Ans. 9d). — U.S.A. (A.A.R.) : By circuiting.

British Railways, the New Zealand Government Railways and Norway : Trains are hand-signalled during the failure.

Ceylon Government Railway, Denmark and Sweden : Personal contact between switchmen and signal box.

Finland : By electro-mechanical interlocking, checking of correspondence between position of point and lever. By relay interlocking indication of point position.

Rhodesia Railways : By the point detection.

Railway Board, India : Point position indication or personal contact.

Question 10. — *Is the employee in charge of the maintenance able to prevent the working of a manoeuvre device while he is carrying out work of a minor kind on this device ?*

Ans. 10. — Answer of British Railways : Not applicable.

The other Administrations : Yes.

Question 11. — *What measures and special devices have you adopted to make impossible an irregular and uncontrolled movement of the points and false controls due to the supply lines being crossed, defects in the insulation, or inductive effects ?*

Ans. 11. — U.S.A. (A.A.R.) : Double wire, double break, ground detectors, megger test of insulation, cross protection circuits.

British Railways and Ceylon Government Railway : High grade insulated wires and cables are used.

The other Administrations : By proper circuiting.

Question 12. — *Do you consider it advisable, in general or in special cases, that the electrical operation of points should be reversible and repeatable several times when the presence of an obstacle (snow, stone, etc.) prevents the blades from travelling their full distance, and the verification of their final position is not possible ?*

Ans. 12. — All Administrations : Yes.

Question 13a). — *What are the statistics of breakdowns classified according to their type : total number of breakdowns and percentage of trains held up, percentage of accidents resulting in relation to the number of trains run or the number of times the points are operated ?*

Ans. 13a). — Ceylon Government Railway state that they have 25 breakdowns per annum. The number of operations per day are 60.

The other Administrations : No statistics available.

Question 13b). — *How many working days does the maintenance of the points operating mechanism involve per annum ?*

Ans. 13b). — U.S.A. (A.A.R.), Denmark, Finland and Norway : No statistics available.

British Railways : Between 12 and 14 days, i.e. monthly or forthnightly visit.

Ceylon Government Railway : 25 man days.

The New Zealand Government Railways and Rhodesia Railways : 3 days per annum.

Sweden : 5 days if points are frequently operated.

Railway Board, India : 2 to 3 days based on 30 to 45 min maintenance fortnightly.

Trailing points.

Question 14a). — *In what cases and for what reasons do you equip points with a trailing device which prevent damage being caused to the points and their motor ?*

Ans. 14a). — U.S.A. (A.A.R.): Trailable points chiefly used in marshalling and classification yards.

Denmark, Norway and Sweden : All points have a trailing device to prevent damage of point and point-machine.

Railway Board, India : Point's motors without locks are used in the marshalling yards or in other traffic yards where shunting is frequent. The lock is omitted to reduce damage in case of points being trailed through.

Question 14b). — *Explain the principles on which the trailing devices you are using work on electrically operated points with or without blade lock :*

i) *case of blades moved independently by the motor mechanism;*

ii) *case of blades connected together by an articulated stem;*

iii) *case in which the blades are rigidly joined by a stem.*

State :

1° *how are they unlocked (if there is an interior or exterior lock) ?*

2° *whether the transmission is reversible and whether the trailing forces the motor to turn ?*

3° *whether accidental trailing uncouples the mechanical transmission from the electric motor and by what means ?*

Ans. 14b). — U. S. A. (A. A. R.) : Question iii) : mechanical disengagement; question 3° : mechanical transmission uncouples the electric motor by special mechanical device.

Denmark and Norway : There are no points with blades joined by a stem. Principle of trailing device : the flange moves the open blade which by the rod is doing the unlocking coincidently pressing a spring until the closed blade opens from the stock rail. The setting of the spring determines the trailing force.

Finland : In points that normally may be trailed there are a reversing device consisting of a counterpiece.

Railway Board, India, states that the motor is not affected (turned) by trailing. No uncoupling of mechanical transmission from the electric motor.

Question 14c). — *How does the Central Post know that trailable points have been trailed ? What effects has this upon the subsequent setting up of routes ?*

Ans. 14c). — U.S.A. (A.A.R.), Norway, Sweden and Railway Board, India: Switches indicate to the Central Post. No effect upon route-setting, full protection.

Denmark : As above; control safety fuse burns.

Finland : In older interlockings the control fuse burns, in newer ones the indication of the switch position goes out.

Question 14d). — *Have you any regulations concerning the maximum speeds at which such points can be trailed ?*

Ans. 14d). — U.S.A. (A.A.R.) : Speed of turnouts governs.

Denmark, Finland, Norway and Sweden : Trailing prohibited, trailing device safety measure only.

The trailing device of Sweden may be trailed at a speed of 40 km per hour (24 m.p.h.) without damage to the switch or switch-machine.

Railway Board, India : No regulations.

Question 14e). — *Have you carried out trials, and with what object, of a type of points mechanism, which after having been trailed forces the blades to complete the movement caused by the trailing until the points are set for the line in the trailing direction ?*

Ans. 14e). — U. S. A. (A. A. R.) : No, except in marshalling yards.

Denmark, Finland, Norway and Sweden : No.

Question 14f). — *What steps do you take to reduce to the minimum the damage caused to and the time taken to repair non-trailable points when a trailing accidentally has occurred?*

Ans. 14f). — U.S.A. (A.A.R.): Operating devices are being built sturdier to withstand the shock, rods usually bend avoiding serious damage to operating mechanisms.

Sweden : Emergency stock of switch-blades and of parts of switch mechanisms.

Railway Board, India : Trailing through of locked points accidentally is rare. The maintainer at the site effects repairs without much delay.

SUMMARY.

As mentioned previously the answers of this report have been concentrated and it is tried to express the view of the different Administrations in as few answers as possible. This has been done partly because of the number of questions in the questionnaire (about 200!), partly because the readers then might better draw their own conclusions.

Some of the Administrations have taken for granted that the questionnaire was concerning C.T.C. only and they have therefore not answered part B.

As to the different answers in the report it is not much to add as conclusions will be drawn up in a special report.

The view of the writer is that section A, remote control of signal boxes, is the most important question dealt with in this report. Practice has shown that technical devices are better, safer and more economical than using man-power in cases where the cost of the installations are reasonable compared with the capitalized value of the reduced expenditures of the wages.

C.T.C. has so far almost exclusively been used in U.S.A. with exceptions of small installations in some other countries. In U.S.A. too there has certainly been resistance against introducing C.T.C. but as practice has shown that C.T.C. is very reliable this system has been introduced on a big scale.

In other countries, operating practices are different from U.S.A., the difference specially in Europe consisting of more man-power in the stations who are setting up the routes and consequently introduction of C.T.C. does not effect much saving of time. C.T.C. should anyhow save a lot of man-power. In other cases, extensions of new tracks may be avoided by introduction of C.T.C.

The following answer of British Railways may be of interest as an expression of another view which so far also is that of most of the Administrations in Europe (writer's assumption) :

« You will be aware that C.T.C. is generally more suitable in countries where the control of traffic has been by means of the train dispatch system, and where, in the case of the growth of traffic, it has been necessary for the lines to be more extensively signalled. Obviously in such cases financial justification can be made out, but in this country it has not been found possible up to the present time to justify economically such installations because the signalling staff, who would be displaced, are required for other duties. »

To section B, the writer has no special comments. An interesting information is that Sudan Railways have installed 3 sets of hand-generator operated points as an experiment.

The information and figures given both in section A and B must certainly in most cases be taken as representative of the present practice and regulations. Older types of operating equipment must certainly still be in use without information on these types having been given in this report.

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Dieselisation of the West Clare Railway,

by J. J. JOHNSTON,

(Assistant Chief Mechanical Engineer, Coras Iompair Eireann.)

The West Clare Railway is one of the railways forming part of Coras Iompair Eireann (Irish Railways) and is situated in the South West part of Ireland; it forms one of the Baronial Guaranteed lines and one of the few remaining narrow gauge systems left in Ireland.

This railway is the result of the amalgamation of two smaller systems, one, the West Clare was incorporated in 1883 and opened in 1887, and the other, the South Clare was incorporated in 1884 and opened in 1892, of approximately equal mileages.

The combined route mileage is 53 miles, shown on fig. 1, consisting mostly of single line of 3′ 0″ gauge making up a total length of track, including sidings of 58 miles.

The gradient profile of the line is given in fig. 2, whilst the sharpest curve on the running line is eight chains. The track is composed of flat bottom rails of 50 to 74 lbs. weight and carried on sleepers spaced at 1 936 to the mile laid on limestone ballast.

The line is single throughout and is of low density and speed, and includes nine passing stations.

The signalling equipment is made up of two types, that from Ennis to Miltown-Malbay being controlled by large type electric train staff instruments, whilst the five remaining sections from Miltown-Malbay to Kilrush and Kilkee are controlled by manual train staff and ticket, with telephonic communication between adjoining stations. The signals are of the semaphore type of the lower quadrant pattern and no distant signals are provided.

Three engine turntables, which were 22 feet in diameter have been extended to slightly over 38 feet to accommodate Diesel railcars.

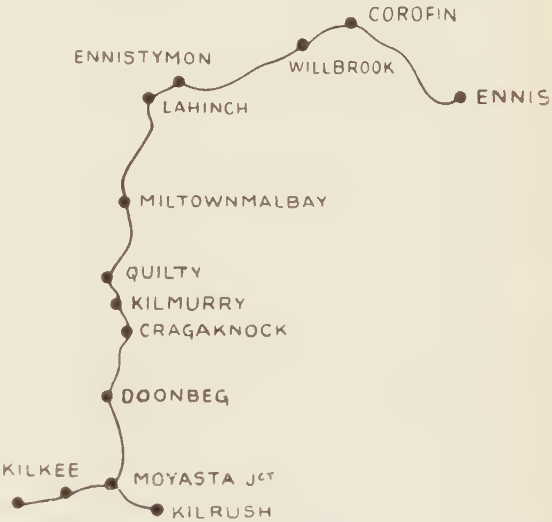

Fig. 1.

The summer passenger service consists of three trains which run daily between Ennis and Kilkee, with a shuttle service of five trains daily between Kilkee and Kilrush, whilst the corresponding Winter

Fig. 2. — Gradient chart : West Clare section.

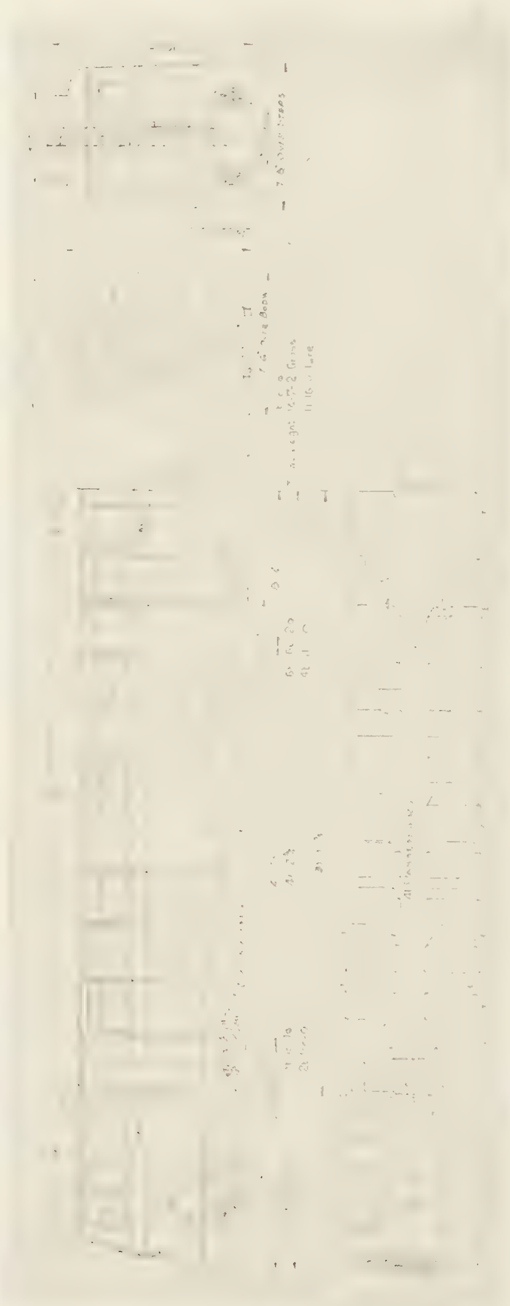

Fig. 3. — Diesel railcar (narrow gauge).

service is composed of two trains daily each way between Ennis and Kilkee, with a four train shuttle service between Kilkee and Kilrush. In addition to the regular passenger service, a further forty special passenger trains are run, mostly during the Summer time on Sundays and holidays.

These services deal with approximately 41 000 passengers per annum, of which over 16 000 are carried in the three Summer months of July, August and September.

The freight service consists of one regular freight train daily each way between Ennis and Kilkee, in addition to which approximately 100 over-load and livestock special trains from fairs, etc. are run.

The total freight dealt with is approximately 12 400 tons per annum, and includes 1 100 wagons of livestock, 285 wagons of beet, 150 tons of grain, 100 tons of coal and over 1 100 tons of turf (or peat).

The rolling stock on the West Clare Section consisted of nine steam locomotives, the leading dimensions of which are shown on the following table, 37 carriages approximately 30 feet long, and 191 four-wheel wagons of 5 tons capacity; in addition four Diesel railcars are now in operation.

The average age of the locomotives is 46 years, that of the carriages is 60 years, whilst 40 years represent the average age of the wagon stock.

Extract from :— Loco Classification 1952	Type « B.N. » 4 — 6 — O				Type « I.N. » O - 6 - 2
Section.	C.	C.	C.	C.	C.
Works Class No.	B.N.1.	B.N.2.	B.N.3.	B.N.4.	I.N.1.
Appendix Load Letter on Page 191.					
Engine class No.	10.C.	11.C.	3.C.	1.C.	5.C.
Cylinders.	15″ × 20″	15″ × 20″	15″ × 20″	15″ × 20″	15″ × 20″
Working pressure	150.	150.	150.	150.	150.
Weight tons in working order.	39.0	36.0	39.5	40.0	38.0
Total adhesive weight.	30.0	28.5	29.5	30.6	
Maximum axle load.	10.0	9.5	10.2	10.2	
Driving wheels diameter.	3′0	3′6	3′9″	3′9″	3′6″
Tractive force at 85 % B.P.	15 940	13 660	12 750	12 750	13 660
	No. 10.	No. 11.	Nos. 3. 7.	No. 1.	Nos. 5 6

Due to the high average age of the rolling stock, with its consequential heavy maintenance charges, and the fact that the line was being operated at a loss, it was decided to dieselise the section completely by the use of light Diesel railcars for the operation of the passenger services and Diesel locomotives for the freight services. The first part of this programme i. e. Diesel railcars for passenger services has been in operation for almost a year now and this has proved so successful that is has now been decided to complete the change over to the complete use of Diesel as quickly as possible.

Four Diesel railcars are now in service, together with three light weight passenger trailer cars and three light weight four-wheel luggage cars, which have been found ample to deal with the normal passenger services.

The type of railcars is shown on the diagram (fig. 3) and consists of a four wheel power bogie complete with driver's cab which was supplied by Messrs. Walker Bros (Wigan) Ltd. and is powered by a Gardner 6 L. W. type Diesel engine developing 102 HP at 1 700 r. p. m., the drive is taken through a Meadows four speed gearbox and by worm to the trailing axles, which is connected to the front axle by outside coupling rods. The driving wheels being 27" diameter. The gear box ratios are as follows :

1st	4.41 — 1.
2nd	2.72 — 1.
3rd	1.62 — 1.
4th	1 — 1.
Rear axle ratio . .	3.555 — 1.

and the maximum speeds in the various gears are :

Top	38.5 m. p. h.
3rd	23.8 m. p. h.
2nd	14.2 m. p. h.
1st	8.8 m. p. h.

Fig. 4. — Conversion of 46C carriage to Diesel trailer.

giving the following tractive effort :

790	lbs.	at	38.5	m. p. h.
1 255	lbs.	at	23.8	m. p. h.
2 110	lbs.	at	14.2	m. p. h.
3 340	lbs.	at	8.8	m. p. h.

The following sets out the mileage which each car has run to date since put into service together with a typical fuel consumption :

Car No.	Mileage	Fuel consumption m. p. g.
3386	18 688	9.1
3387	26 530	9.2
3388	22 821	9.1
3389	12 789	9.3

The passenger units complete with trailing bogies, which were designed and built by the Railway Company, are attached to the power bogie on a pivot centre, thus making up the complete rail-car unit; bus type seats are provided for 41 passengers of one class only, as it was found advantageous to eliminate one of the classes when operating Diesels on this section.

Fig. 5. — Proposed general arrangement of locomotive (204 HP), (narrow gauge).

The passenger trailer cars (diagram fig. 4) also have bus type seats for 38 passengers, they were made up by the Railway Company from existing carriage underframes and bogies, using old road omnibus bodies and seating, and these make up a suitable light weight unit of ample proportion for the service.

Electric lighting is fitted throughout the passenger cars and is fed from the

12 volt nickel cadmium starting battery in the power unit.

It was necessary to make provision for three light weight baggage cars to deal with the heavier passenger luggage and other traffic. These cars were built on light weight four-wheel wagon underframes of 6′ 0″ wheelbase, the body being of light weight construction with a carrying capacity of one ton.

The diagram (fig. 5) shows the type of Bo-Bo Diesel locomotive which is now under consideration for dealing with freight trains and one of the important features of the proposed locomotive being that as many parts as possible should be interchangeable with the rail-cars in order to reduce maintenance charges and cost of spare parts.

[625 .1 (43)]

The renewal of a retaining wall at Frankfort South station,

by Karl Heinrich HANSEN,

Engineer, Reichsbahnrat, Francfort Main.

(*Der Eisenbahn-Ingenieur*, No. 10, October 1952.)

There is nothing remarkable in itself in the rebuilding of a retaining wall, but in the present case, the solution adopted was somewhat out of the ordinary, and in my opinion, worth bringing to the notice of a wider circle.

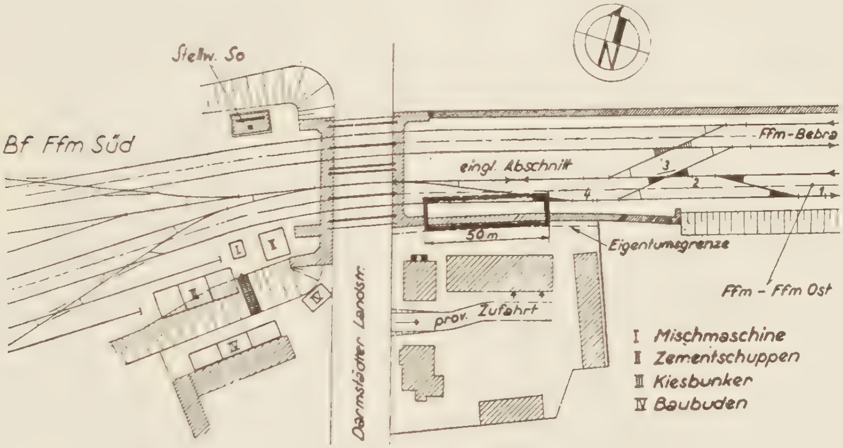

Fig. 1. — Plan of the site and organisation of the work.

I : concrete making yard. — II : cement store. — III : reserves of gravel. — IV : work sheds.

Explanation of German terms:

Eingl. Abschnitt = single track section. — Eigentumsgrenze = boundary of land owned. — Prov. Zufahrt = provisional cart track. — Bf Ffm Süd = Frankfort-South Station. — Stellw. = points.

1. Preliminary remarks.

The four main lines from Frankfort/Main South (Frankfort-Bebra and Frankfort South to Frankfort East) are about 5 m (16′ 5″) above ground level on an embankment which after the Darmstadt road runs under it, is held between two retaining walls, the sites on either side being built up (see fig. 1). In 1912, when the road was taken under the railway, the lines were raised and the retaining walls made higher without increasing their section. As a result these walls were no longer strong enough to withstand the increasing loads, which was shown in the case of the wall on the inside of the curve by bending and an inclination of as much as 43 cm (1′ 4 15/16″) as well as by the formation of cracks in a 50 m (164′ 1/2″) long section.

The checks carried out every month since July 1949 by the Geometrical Department confirmed that there was a slight displacement. A more thorough check made in 1950 showed that the masonry was not only of insufficient section but also of poor quality.

To reduce the immediate risks to the train working, in the spring of 1951 the whole question of rebuilding this 50 m section of the retaining wall which seemed likely to collapse was gone into.

2. Conditions of ownership.

It was particularly difficult to clear up the question of ownership because the plans available were insufficient. A great number of measurements made on the site showed that a strip of land about 50 cm (1′ 7 11/16″) wide still belonged to the German Federal Railways. It was decided to take the retaining wall right out to the boundary in order to make it possible to widen the space between tracks.

It was impossible to carry out this work without going on to adjoining property.

3. Project.

The Frankfort Management first of all prepared a project for a solid wall, the Frankfort-South to Frankfort-East line being closed to traffic and the adjoining main lines being kept open by means of a continuous row of timbers anchored to the opposite sustaining wall. They then put the scheme up to tender, inviting contractors to put forward their projects avoiding as far as possible any excavation owing to the close proximity of the track. Whilst one of the lines was closed, about 182 regular trains had to run over the other line, so that it was practically impossible to find any sufficiently long intervals to enable sinking operations to be carried out (propping up with planks and the actual excavation).

Seventy per cent of the contractors consulted put forward special projects together with their tender for the main scheme. The special project of the firm of Grün and Bilfinger was adopted as being that best adapted to operating requirements, local conditions and economic considerations.

The project (fig. 2) was based on the idea that if the Frankfort-South—Frankfort-East line was closed, and taking into account the natural slope of the embankment, there was no need for any special consolidation of the other lines, on condition that the old sustaining wall was not demolished as far as the lower level of the foundations.

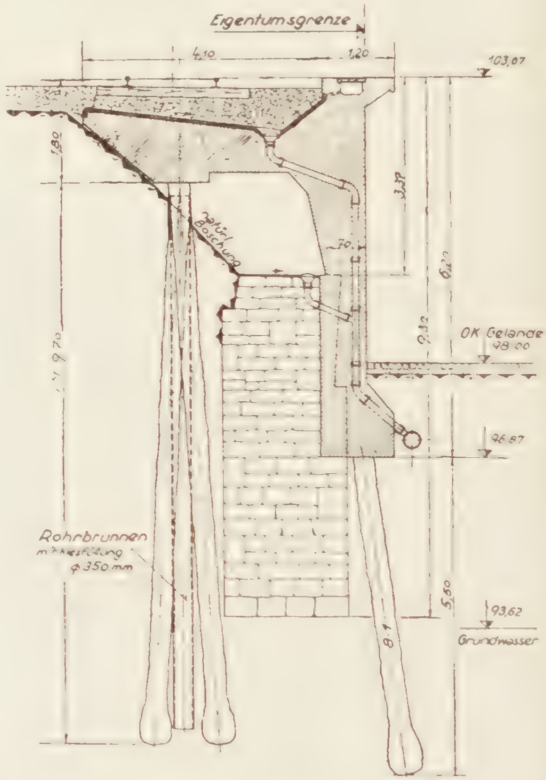

Fig. 2. — Project.

Explanation of German terms:

Eigentumsgrenze = boundary of land owned. — OK Gelande = level of the ground. — Grundwasser level of the water-bearing strata. — Naturl. Boschung = natural slope. — Rohrbrunnen = Tubular pits filled with gravel.

The following operations were provided for :

Demolition of the old wall up to about 3.30 m (10′ 9 15/16″), removal of the covering masonry on the lower part of the wall which was being retained, up to 2 m (6′ 6 3/4″) above ground level, laying a concrete apron 80 cm (2′ 7 1/2″) thick resting against the old wall and on a line of reinforced concrete footings immediately in front of the wall. The apron was to form a support for a reinforced concrete pavement placed below the Frankfort-South—Frankfort-East line (laid while the work was being carried out). The pavement also rests on a line of cast piles against the old wall.

To withstand horizontal stresses, the railway stipulated that the piles must have the proper inclination for the work. The piles in front of the wall were given an inclination of 8 : 1 compared with the wall, and those behind it, an inclination of 20 : 1 maximum, alternately towards the front and towards the rear. In front of the wall the piles had an average length of 5.50 m (18′ 11/16″) and behind it, 9.7 m (31′ 9 7/8″); in both cases they were put 1.10 m (3′ 7 5/16″) apart. The angle where the paving links up with the apron was reinforced to resist bending and the space under the paving left open so that observations could be carried out.

With this solution, the structure does not have to support any stresses from the rest of the embankment, but only those from the Frankfort-South—Frankfort-East line.

So far no provision for drainage had been made for the embankment which is imprisoned between the sustaining walls and the abutment of the bridge. To remedy this, along the centre line of the rear piles 10 tubular pits of 350 mm (1′ 1 3/4″) diameter have been made filled with gravel and reaching right down to the water-bearing strata.

4. Carrying out the work.

a) *Preparatory steps.*

Before closing the Frankfort-South—Frankfort-East line, a new junction and crossing were made (fig. 1, items, 1, 2 and 3) so that single line working could be used on the Frankfort-East—Frankfort-South line. At the same time, trial soundings were made in order to obtain the necessary information about the nature of the soil. From the results of these soundings, it appeared that suitable soil could be expected about 11.5 m (37′ 8 11/16″) below rail level. The water-bearing strata was found to be 10 m (32′ 9 3/4″) below rail level.

The access to the premises of the owner of the adjoining property had to be closed while the work was being carried out. A small roadway 3 m (9′ 10 3/8″) wide was made with sleepers on his land behind the buildings to serve as an emergency entrance (fig. 1).

b) *Organisation of the work site :*

The organisation of the work site is shown in figure 1. Gravel and cement were delivered by wagon and the shelter for the cement as well as the reserves of gravel and concrete making equipment were installed on the bed of the embankment. To transport the concrete a field line was built following the axes of the Frankfort-South—Frankfort-East line closed to traffic. The sheds were at the foot of the embankment. A staircase cut in the side of the embankment enabled the men to get to the place of work without having to cross the lines. Motor lorries took away the spoil.

c) *Progress of the work :*

Two and a half months were allowed for carrying out the work, from the time the Frankfort-South—Frankfort-East line was closed until it could be re-opened. In order to carry out the work in such a short time, it was necessary to work day and night, even on Sundays.

As soon as the services were altered, the track was dismantled and the old wall, as well as the bed of the track were removed to a depth of 1.80 m (5′ 10 7/8″) to the bottom level of the reinforced concrete paving. Before proceeding with the work of demolition, the rear line of piles were excavated and run in. They were excavated by means of three hand operated machines spaced over the work. The inclination of the rear line of piles could not be made uniform because the wall and the track are not parallel, so that the piles leaning towards the wall would have come against it.

Owing to the level of the water-bearing strata, the concrete was run in an air-lock under a pressure of 4 kg/cm² (56 lbs. per sq. inch). Above the level of this strata, the concrete was run in without ramming and merely compacted by means of an internal vibrator. The vibrator was suspended 60 cm (1′ 11 5/8″) below the excavating tool, connected up to this tool and drawn up regularly with it. The concreting of the piles and the work of vibration were very closely supervised and careful note taken of the time needed and the consumption of concrete.

The piles were reinforced by means of a spiral reinforcement which was inserted in one piece, having been prepared beforehand.

Diameter of the reinforcement : 29 cm (11 7/16″); diameter of the bore : 35.5 cm (1′ 1 3/4″), concrete B 300; consumption : 0.140 m³ (0.183 cub. yard) per metre of pile.

The time taken to run the concrete in with internal vibration is very much the same as with the old method of compacting it by pressure, although the introduction and removal of the vibrator are complicated operations taking up a lot of time. The consumption of concrete was on the average greater than the calculated consumption, so that the resulting concrete must be denser owing to internal vibration. In the orders for the use of internal vibrators for compacting concrete (DIN 4235, project of October 1950, published in « Beton- u. Stahlbetonbau », 46th year, No. 4, April 1951), no mention has yet been made of the concreting of cast piles with internal vibrators. This application will have to be introduced after very extensive research work.

The 10 tubular pits for drainage were bored in the same way and filled with gravel.

The boring had to be carried out 3.7 to 4 m (12′ 1 5/8″ to 13′ 1 1/2″) away from the centre line of the line still in operation, as we have already stated, with 182 regular trains running at 30 km (18.6 miles) h. The work was never upset nor was the operating.

At the same time as the line of rear piles was completed, the work of demolition was proceeded with and the facing removed to the level of the new retaining wall. Then the front line of piles could be proceeded with. Contrary to what was expected from the previous examination, the old wall was found to have a good structure throughout its length. There was therefore no disadvantage in leaving the small amount of stress allowed for in the project for the old masonry and giving up the idea of strengthening the part of the old wall retained.

The new 50 m long wall was divided

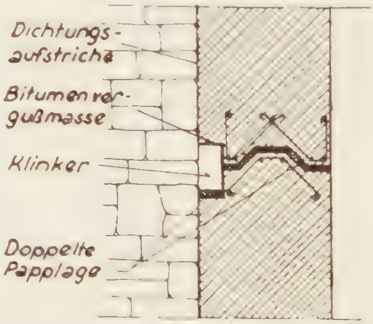

Fig. 3. — Arrangement of the joints.

N. B. — Dichtungsaufstriche = watertight layer. — Bitumenvergussmasse = layer of asphalt. — Klinker = hard brick. — Doppelte Papplage = double layer of cardboard.

up by joints into 5 parts each about 10 m (32′ 9 3/4″) long, and the concrete was run in a single operation in each section (for the arrangement of these joints see fig. 3).

In each part a 0.10 × 0.30 m (3 15/16″ × 11 13/16″) air opening was provided at the level of the space left under the paving. Steel shuttering was used for the outer surfaces. The joint with the old wall was given a smooth finish. The carrying paving was completely waterproofed as laid down in the regulations and given a protective coating of cement (fig. 4).

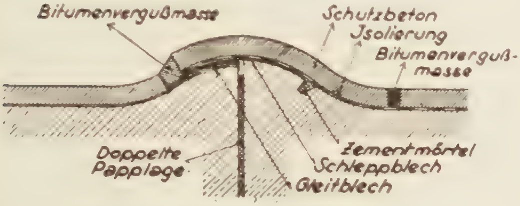

Fig. 4. — Covering of the joints.

N. B. — Bitumenvergussmasse = layer of asphalt. — Doppelte Papplage = double layer of cardboard. — Schutzbeton = concrete covering. — Isolierung = insulation. — Zementmortel = cement mortar. — Schleppblech = built in steel plate. — Gleitblech = sliding steel plate.

To give access to the space under the paving for future inspection, an inspection pit was made, opening in the upper part, so that the paving, apron and back line of piles could be examined at their upper part (fig. 5).

In addition, measuring marks were built into the concrete of the new part so that check measurements could be made there.

The Frankfort-South—Frankfort-East line was reopened to traffic at the appointed time.

Checks carried out before and after putting it into service, as also observations made in the inside did not reveal any changes.

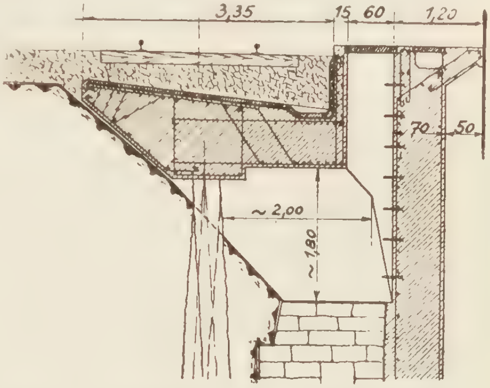

Fig. 5. — Cross section of the inspection pit.

d) *Materials.*

Generally, it should be noted that with the method of work selected the masses involved were considerably less than with a retaining wall whose strength lies in its own weight. For example, the masses of the demolitions and earthworks were only 37 % of the figures calculated for a wall, and the quantity of concrete used, only 35 %. This is the essential point, and in view of the lack of space at the work site, had a decisive effect upon the time taken to carry out the work.

NEW BOOKS AND PUBLICATIONS.

[**385** (09 (3)]

World Railways 1952-53. — A Survey of the Operation and Equipment of representative rail systems. — Second edition. — Composed and published by Henry SAMPSON. — One volume (8 3/4 × 13 inches) of 550 pages with numerous illustrations and maps. — 1953. London, WI., Sampson Low, Marston & Co. Ltd., 25 Gilbert Street. (Price : £ 4.4.0 d. net.)

A work of this kind is not one which needs successive editions at short intervals. If after 18 months, the publishers considered a second edition was called for, this was chiefly on account of the welcome engineers and industrialists gave to the first. They were also encouraged to do so by the amount of official information received about hundreds of railways about which very little had previously been known.

The interest of this new edition however lies above all in the rapidity of the technical progress made by railways all over the world. Whereas formerly, a study dealing with the equipment of the permanent way might remain valid over a fairly long period, this is no longer the case nowadays. The rolling stock, both traction and transport, the signalling and the train services, the construction and maintenance of the permanent way and other sections of the railway industry are profiting all the time from new inventions and new ideas.

As in the first edition, the book is divided into six regions : North America, South America, Europe, Africa, Asia and Australia. The countries are arranged in alphabetical order as are the railways of each country.

Many new maps have been included and others revised, and for many countries there is a map for each railway.

The notes giving the characteristics of the lines have been revised and amplified. They deal in particular with the permanent way (construction, gradients, curves, axle loads, speed, loads allowed on bridges), the traffic (details of the receipts), the train services and signalling, the history of the railways, their mileage and finally the composition of the rolling stock.

No doubt because it is the very soul of the railway, the traction stock holds pride of place in the documentation and illustrations. All the methods of making use of the power provided by nature are represented, as well as all the methods of transforming and transmitting it. Here one can find all the most interesting characteristics and even detailed descriptions of steam locomotives, electric locomotives, diesel locomotives, diesel-electric locomotives, railcars and finally gas turbine locomotives. The transport stock is represented by a large number of examples, in which a study of the best arrangements is compared with the best stock. The most celebrated trains are mentioned together with the records for load, speed and mileage.

Civil engineering works are not forgotten. The profiles of particularly difficult lines, the lengths of tunnels with the altitudes reached, the principles upon which large bridges have been built and their dimensions testify to the ingenuity and audacity of the creators of these railways.

It would be difficult to exaggerate the value of the information contained in this book which covers the railways of the whole world. It is an invaluable reference book for the railway engineer and for the builders of railway stock.

E. M.

[**313** .656 (494)]

Schweizerische Verkehrsstatistik, 1951 *(Swiss transport statistics.)* — 1952, Berne, published by the *Federal Transport Office.* — One volume (8 1/4 × 11 1/2 inches) of 144 pages and 9 tables (Price : 12 Swiss fr.)

The object of this publication is to give a periodical summing up of the progress achieved by public transport in Switzerland.

The data collected and given in the form of numerical tables relate to all kinds of mechanical transport : the general railways, special railways, local transport, road traffic, navigation, air traffic. For the first time this year, private traffic has been taken into account; such traffic holds a considerable place in the Swiss transport economy. Again for the first time, the volume includes information on maritime traffic sailing under the Swiss flag.

The general traffic statistics for the railway are very detailed. They include details about the constitution of the system, the composition of the stock, the mileage, the traffic, the staff, the operating accounts, the constructional costs, the balance sheet.

In a general way, Swiss transport undertakings enjoyed a favourable economic position in 1951. The Federal Railways saw an increase in the traffic and their receipts rose correspondingly, which resulted in a very favourable financial result. Equally satisfactory results were obtained by the private railways as regards the general traffic.

In the case of the special railways, which covers the rack railways, funicular railways and telefer railways, the statistics are necessarily less detailed, though interesting information is given about the size, equipment and activity of these various undertakings. Here again the traffic increased, especially in the case of the telefer railways to which extensions were made in 1950. The operating coefficients, though good, are generally lower than those for the previous year.

In the case of local transport, there was a movement of the traffic away from the tramways to the buses and trolleybuses, owing to the substitution of different methods of transport. On the remaining tramways, the traffic increased. In the case of the trolleybuses and buses the increase is very appreciable.

The first striking feature as regards private road traffic is the great leap in number of motorcars which increased by 125 % compared with the last year before the war. In the case of motorcycles, the increase was as much as 300 %. The volume of road traffic is obtained however from figures relating to the entry of foreign cars, transport in foreign cars and international transport by lorries passing through Swiss territory.

The navigation on the lakes, another factor of Swiss tourist traffic, also recorded an increase in the number of people carried compared with 1950, and a fall in the average operating coefficient.

As for the Rhenisch ports, the amount of goods transported reached a figure in 1951, which has never been equalled since 1937.

As regards the air services, there has been a very considerable increase in traffic. This can be seen both in the Swiss air services inside Switzerland and abroad on the foreign air lines. This applies to the regular services, since Swiss charter air services have fallen off whereas the foreign traffic has picked up.

Containing solely instructive statistics, this volume carefully prepared by the Federal Transport Office gives a basic picture of the evolution of transport in Switzerland.

E. M.

MISCELLANEOUS INFORMATION.

Award of the Institution of Locomotive Engineers' Gold Medal.

We have the pleasure to announce to our readers that the Council of the Institution of Locomotive Engineers have awarded the Institution's Gold Medal (their highest award) to Mr. R. A. RIDDLES, C.B.E., Member for Mechanical and Electrical Engineering and a Member of the Permanent Commission of our Association.

The Gold Medal, which was first awarded in 1946, is awarded at the discretion of this Council for special, or meritorious services in connection with the profession of Locomotive Engineering. The Council of the Institution of Locomotive Engineers, in making the award, recognize the outstanding services rendered by Mr. RIDDLES and his staff on British Railways during the last few years.

The presentation will be made at the opening General Meeting of the 1953/54 Session of the Institution in September next.

We are pleased to express our sincerest congratulations to Mr. R. A. RIDDLES on behalf of the Permanent Commission of our Association.

The Executive Committee.

Results of the competition for new designs of track brakes held by the German Ministry of Transport.

In a note published in the October 1952 Bulletin, page 752, we drew the attention of our readers to the Competition for new designs of track brakes organised by the Ministry of Transport of the German Federal Republic.

This competition closed on the 16th February 1953. Twenty-two entries were sent in within the allotted time, ten of which were accepted by the Jury which was presided over by Dr. A. BAUMANN, Engineer, former President of the Management of the Reichsbahn, and consisted of eminent personalities of German railway circles.

The distribution of prizes to the winners took place at Darmstadt at a meeting on the 15th May last. Two prizes of 12 000 D.M. apiece were awarded, as well as a third prize of 8 000 D.M. The first prize of 25 000 D.M. was not awarded in view of the fact that none of the entries received completely fulfilled the conditions laid down. The surplus prize money was given to five other designs at 3 500 D.M. each.

The prize designs, put forward by eminent German and foreign technicians, are to a large extent a concrete application of new principles and methods of construction, and will be published in the Review *Eisenbahntechnische Rundschau* as laid down in the competition regulations.

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(AUGUST 1953)

[016. 385. (02]

I. — BOOKS.

In French.

1952 — 536
CHAMBADAL (P.).
Les machines thermiques.
Paris : Librairie Armand Colin. Un volume in-16, de 214 pages, avec 71 figures. (Prix : 260 fr. fr.)

1953 — 624 .2
CHARON (P.).
La méthode de Cross et le calcul pratique des constructions hyperstatiques.
Paris : Eyrolles, éditeur. Un volume (17 × 25 cm) de 304 pages, avec 260 figures. (Prix : 3 800 fr. fr.)

1953 — 625 .62
GIUPPONI (F.) & PARIBENI (M.).
La pénétration des services suburbains dans les Réseaux urbains. Rapport V du XXX[e] Congrès International (Madrid, 1953), de l'Union Internationale des Transports Publics.
Bruxelles : Union Internationale des Transports Publics, 18, avenue de la Toison d'Or. Une brochure (21 × 27 cm) de 26 pages de texte, avec de nombreux plans en annexes.

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La « **Volkswagen** » **du Rail.** (250 mots & fig.)

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Diesel-mechanical locomotive performances. (2 200 words & figs.)

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